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Identity Management for Modern Infrastructure

Worcester Linux Users' Group

Dmitri Pal
Director of Engineering, Red Hat, Inc.
12/10/2015

AGENDA

Worcester Linux Users' Group

7:00PM—7:20PM
Identity Management High Level View

7:20PM—7:35PM
Introduction to Kerberos

7:35PM—8:00PM
Active Directory Integration

8:00PM—8:25PM
FreeIPA/IdM Introduction

8:25PM—8:40PM
Indirect Integration using FreeIPA/IdM

8:40PM—8:50PM
Application Integration

8:50PM—9:00PM
Questions

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Identity Management High Level View

Modern Enterprise

Simplified view

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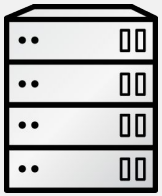
Modern Enterprise

Simplified view

Servers



Windows
Linux
UNIX

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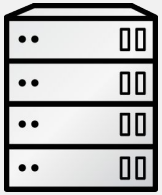
Modern Enterprise

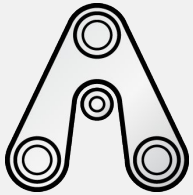
Simplified view

Servers



Windows
Linux
UNIX

Services



Internal
and
External

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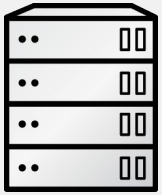
Modern Enterprise

Simplified view

Servers



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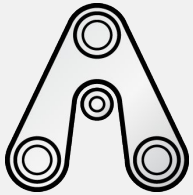
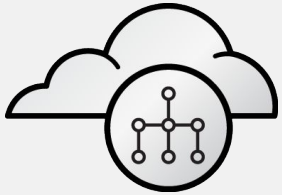
Services



Internal
and
External

Clouds



Private
and
Public

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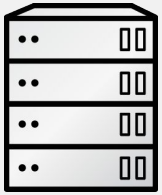
Modern Enterprise

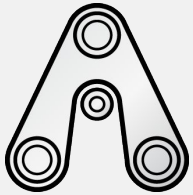
Simplified view

Servers



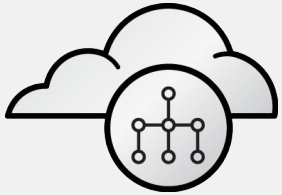
Windows
Linux
UNIX

Services



Internal
and
External

Clouds



Private
and
Public

Applications

BM
VM
Container

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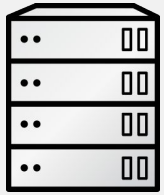
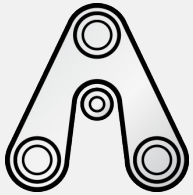
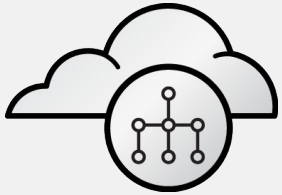
Modern Enterprise

Simplified view

Servers	Services	Clouds	Applications	Tools
				
Windows Linux UNIX	Internal and External	Private and Public	BM VM Container	Developer QE/QA DevOp/IT

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Modern Enterprise

Identity View

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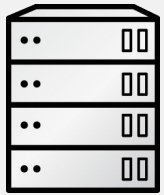
Modern Enterprise

Identity View

Servers



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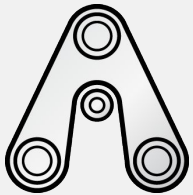

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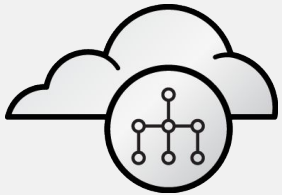
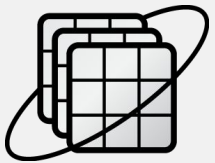


Applications

Tools



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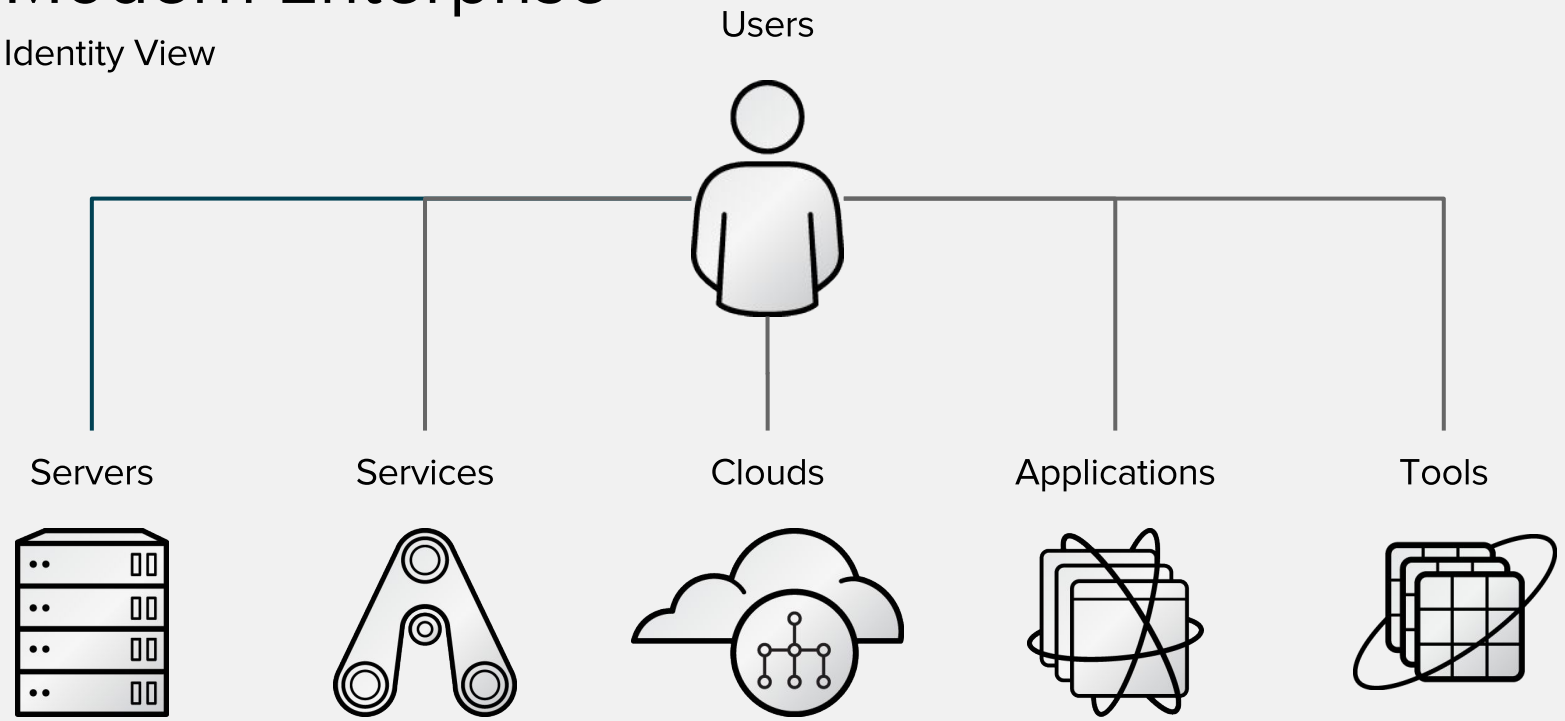
Modern Enterprise

Identity View



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Users

In Modern Enterprise

Employees
Contractors

Customers
Partners

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Users

In Modern Enterprise

Internal Namespace

Employees
Contractors

External Namespace

Customers
Partners

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Internal Namespace

Focus of this presentation

Internal Namespace

Employees
Contractors

External Namespace

Customers
Partners

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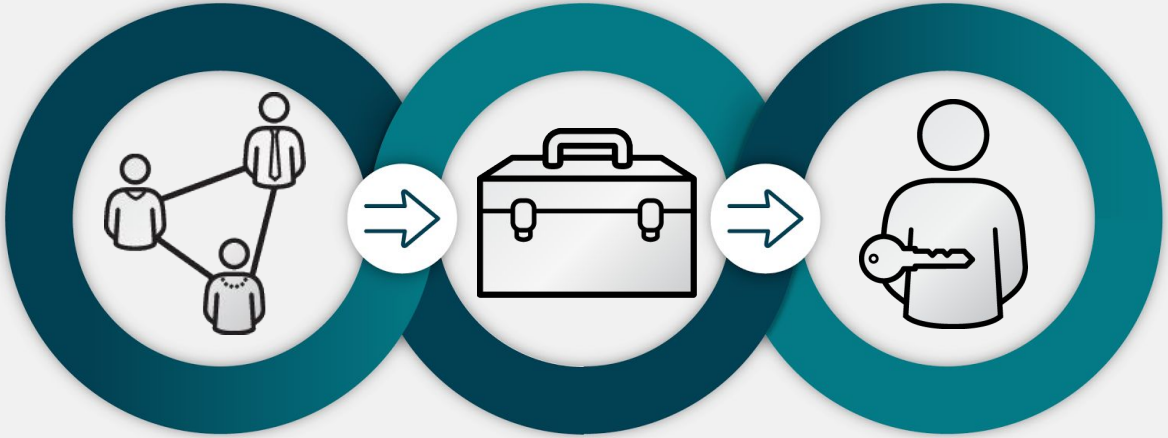
Internal Namespace

Traditional Model



HR Database

Identity Management System

User Storage per Application

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Traditional Identity Model

Weaknesses

- Complex
- Costly
- Applications are isolated
- Hard to manage and make sure that all systems are aligned
- Hard to be compliant with different regulations

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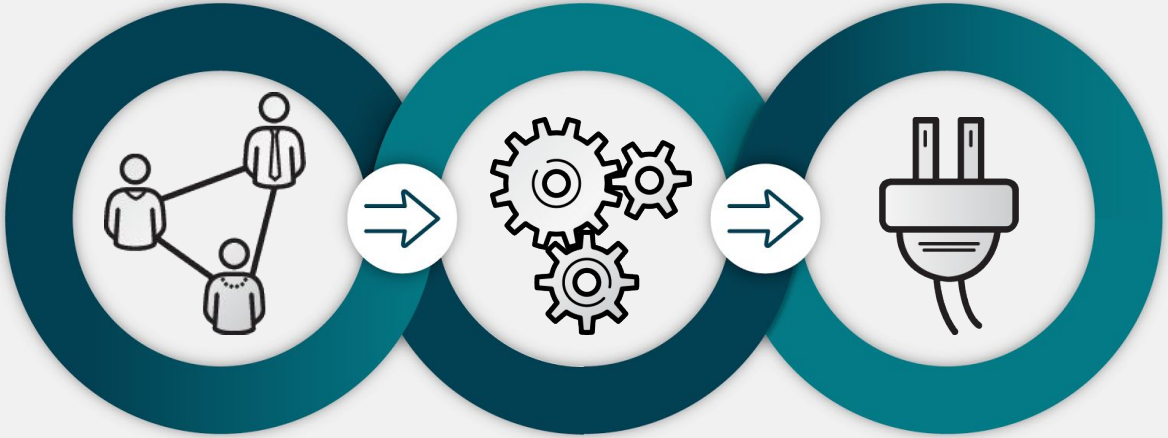
Internal Namespace

Modern Model



HR Database

Central Identity Store

Application Users from a single store

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Modern Identity Model

Pros and Cons

- Less complex, however, still has a fair amount of complexity
- Less costly
- Applications plug into a common identity source directly and indirectly but still need additional data
- Easier to manage but still has challenges

There is no silver bullet but the more control you have the better the result is.

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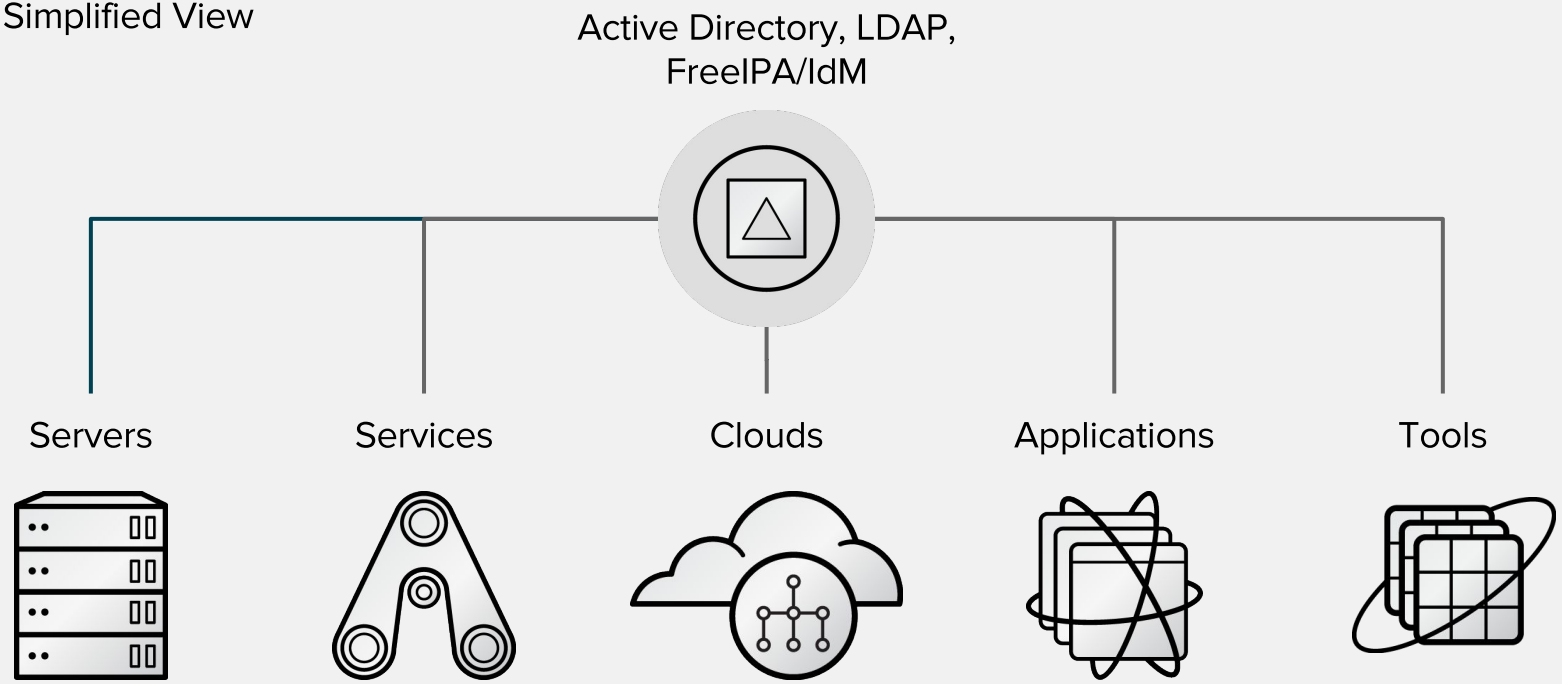
Modern Identity Model

Simplified View



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Modern Identity Model

Challenges if you use a pure LDAP solution

- Usually a home grown custom solution that is hard to support
  - A lot of craft and magic
  - Hard to modernize
  - Costly to maintain
- Windows client systems still require AD
- How you deal with SSO?

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How to deal with SSO

Overview

- Platform level:
  - ~~NTLM~~ - old, weak crypto, should not be used
  - **Kerberos** - old, went a long way, recommended
- Application level:
  - ~~OpenID~~ - old, has weaknesses, should not be used
  - **SAML** - old, proven, recommended, challenges with mobile
  - **OpenID Connect (OIDC)** - modern, proven, recommended for new applications

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How to deal with SSO

Bottom Line

Use Kerberos, SAML, OIDC and a combination of them based on the use case.

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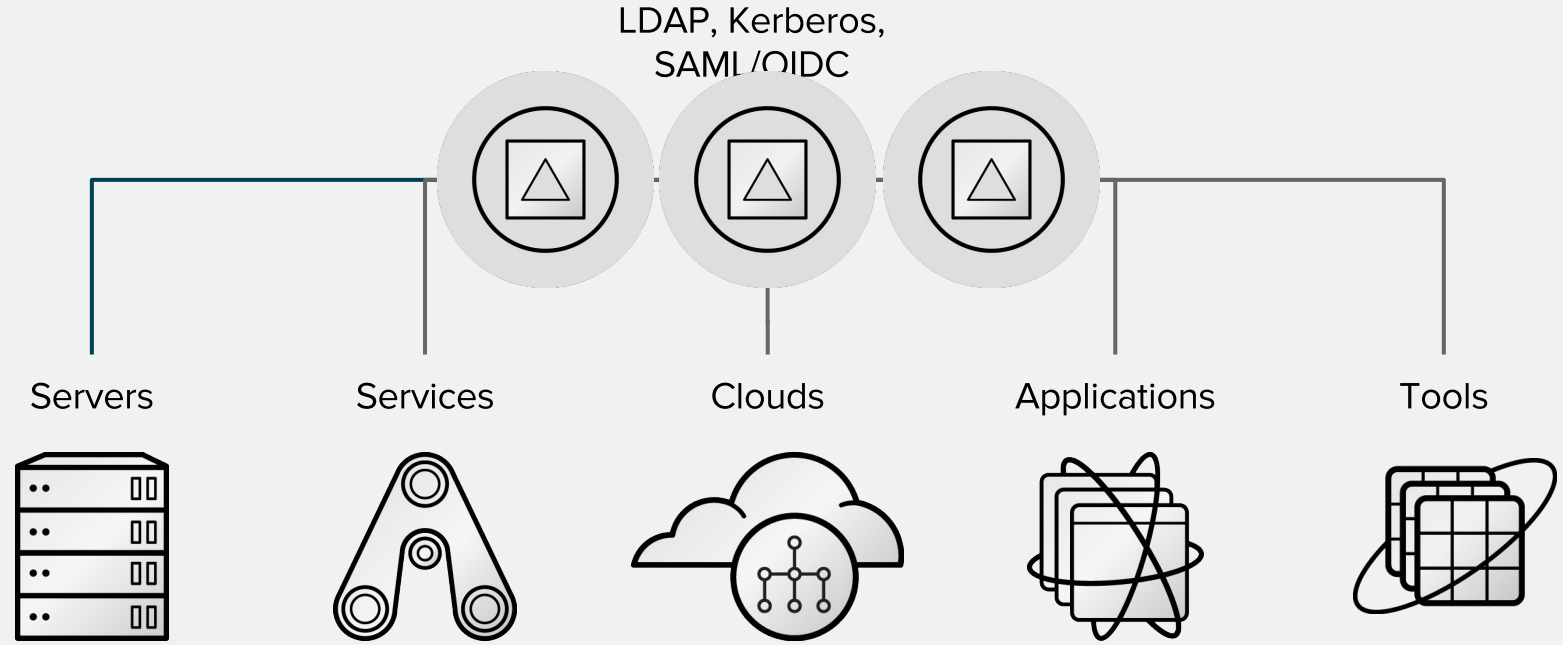
Modern Identity Model

LDAP Solution



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LDAP Based Solution

Recommendations

- Since the solution has many limitations, costly and hard to maintain and migrate from the recommendation is not to embark on that path
- If you already have it, consider moving off it instead of continued investment into it. The more you invest, the harder it will be to modernize and move off in future.

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NIS

Added for completeness

- NIS is a UNIX focused solution of the past
- It is very limited and insecure
- It does not meet modern compliance requirements
- If you have it move off ASAP

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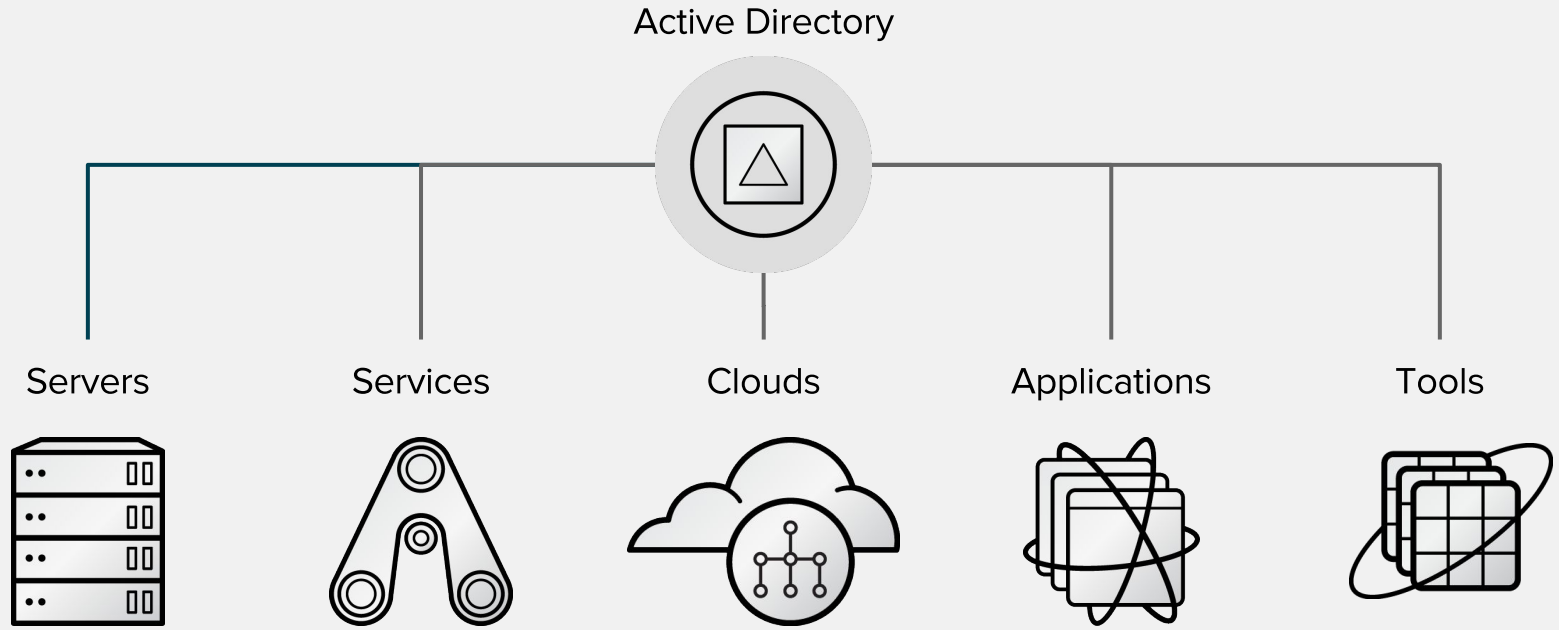
Modern Identity Model

Active Directory based solution



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Modern Identity Model

Challenges if you use an AD focused solution

- How to deal with policies and access control?
- How to handle different domains and forests?
- How to deal with lack of control over Active Directory?
- How to handle POSIX?
- How SSO works in this case?
- How deal with additional data that needs to be stored somewhere?

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Modern Identity Model

Challenges if you use an AD focused solution

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A section will be dedicated to this conversation

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Modern Identity Model

Challenges if use a FreeIPA/IdM solution

- Windows client systems still require AD… A non starter?

Another section will be dedicated to this conversation

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Introduction to Kerberos
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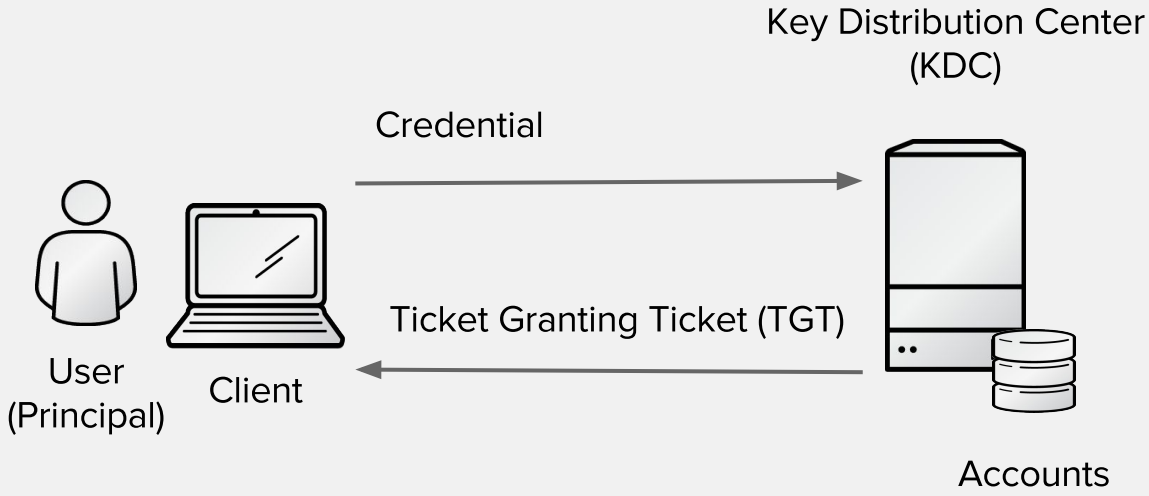
Kerberos Authentication

User authentication



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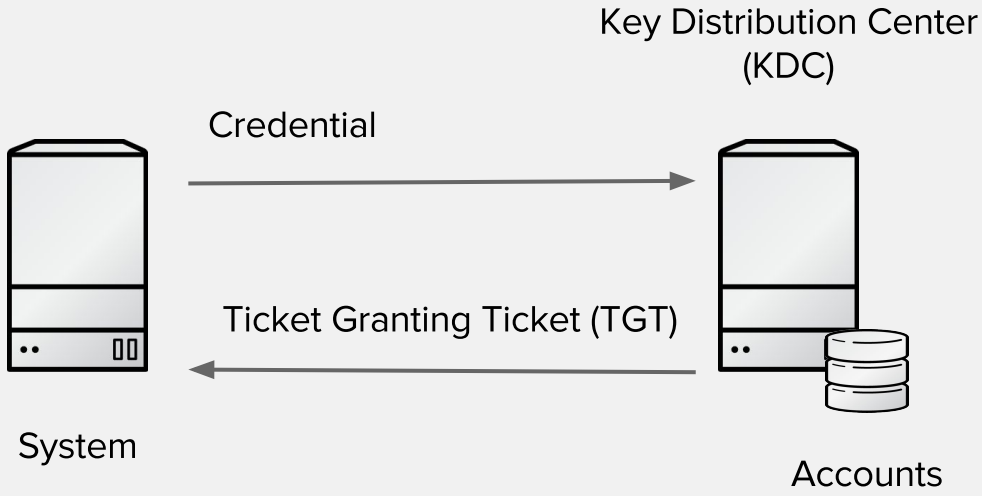
Kerberos Authentication

System authentication



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Credentials in Kerberos

Overview

- Password/Key
  - User password - something that user remembers
  - System key - long and strong that can be used by a system
- Certificate (pkinit)
- OTP
  - Tunnelled
  - SPAKE

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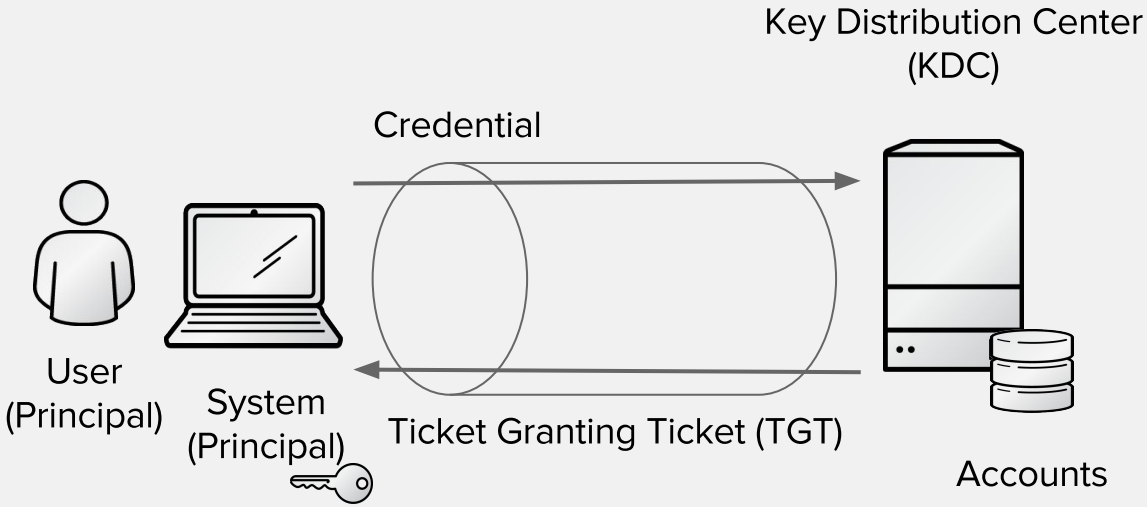
Tunnelled Authentication

Secure Tunnel



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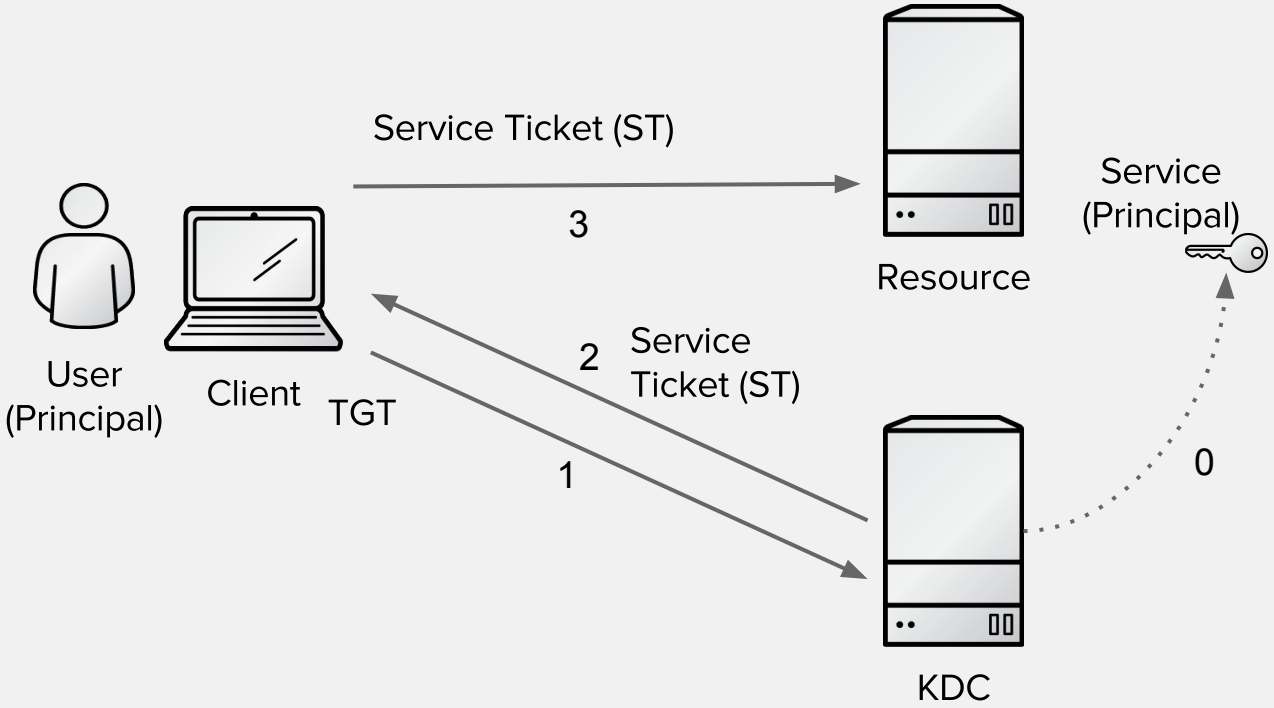
Kerberos SSO

Accessing a resource



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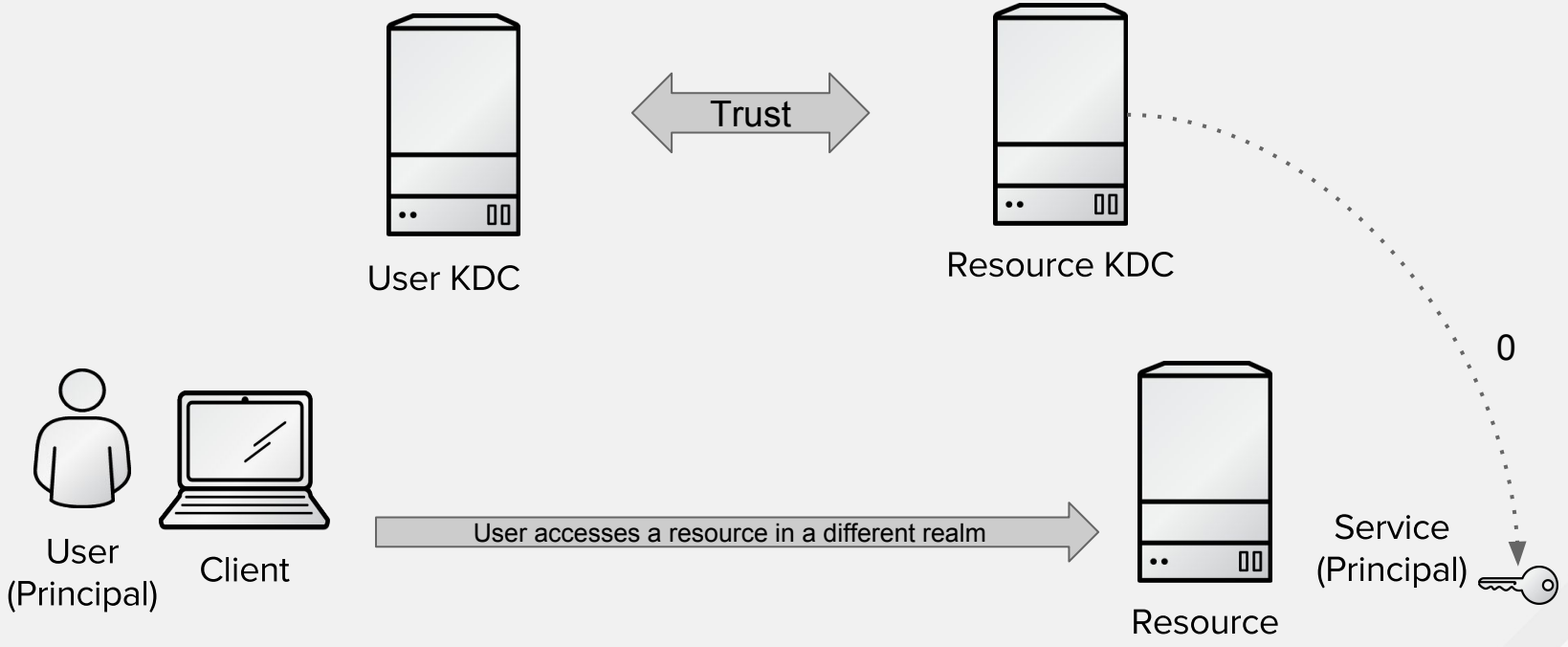
Trust Case

Accessing a resource in different Realm



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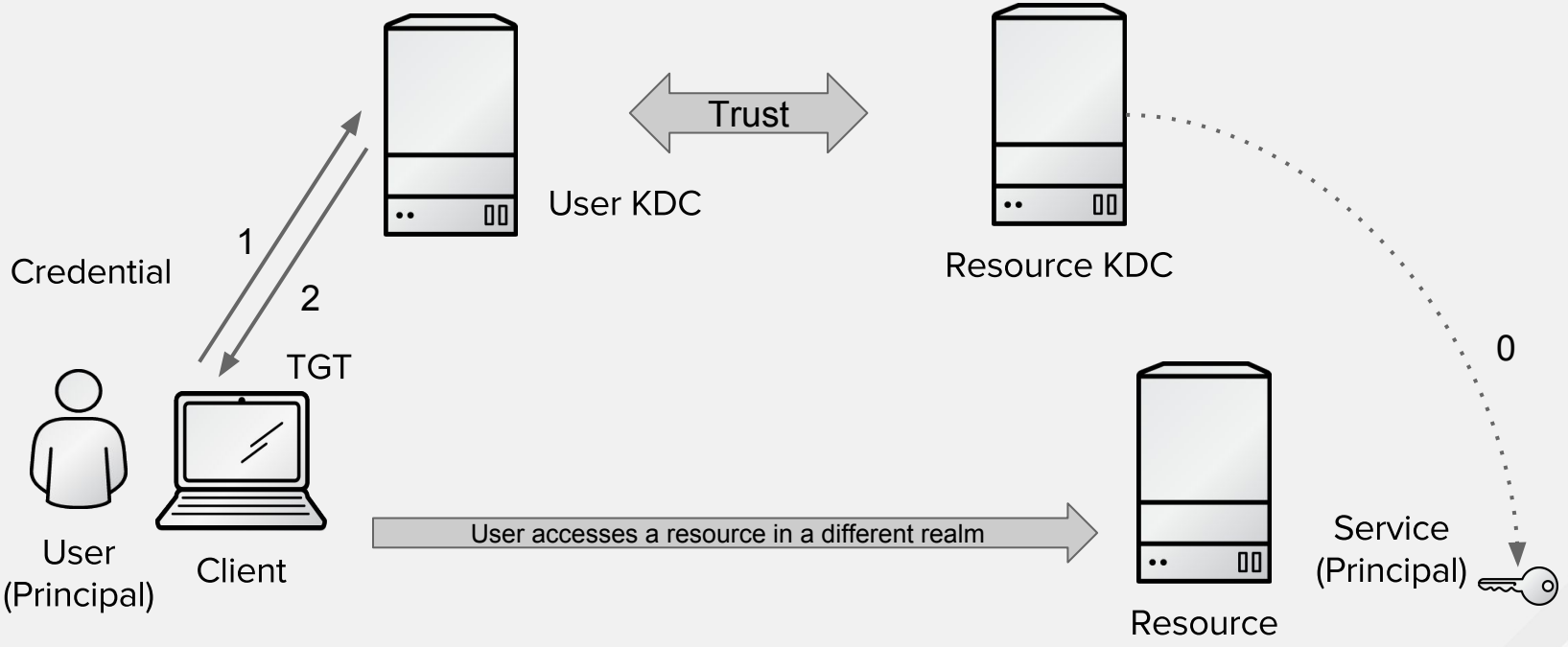

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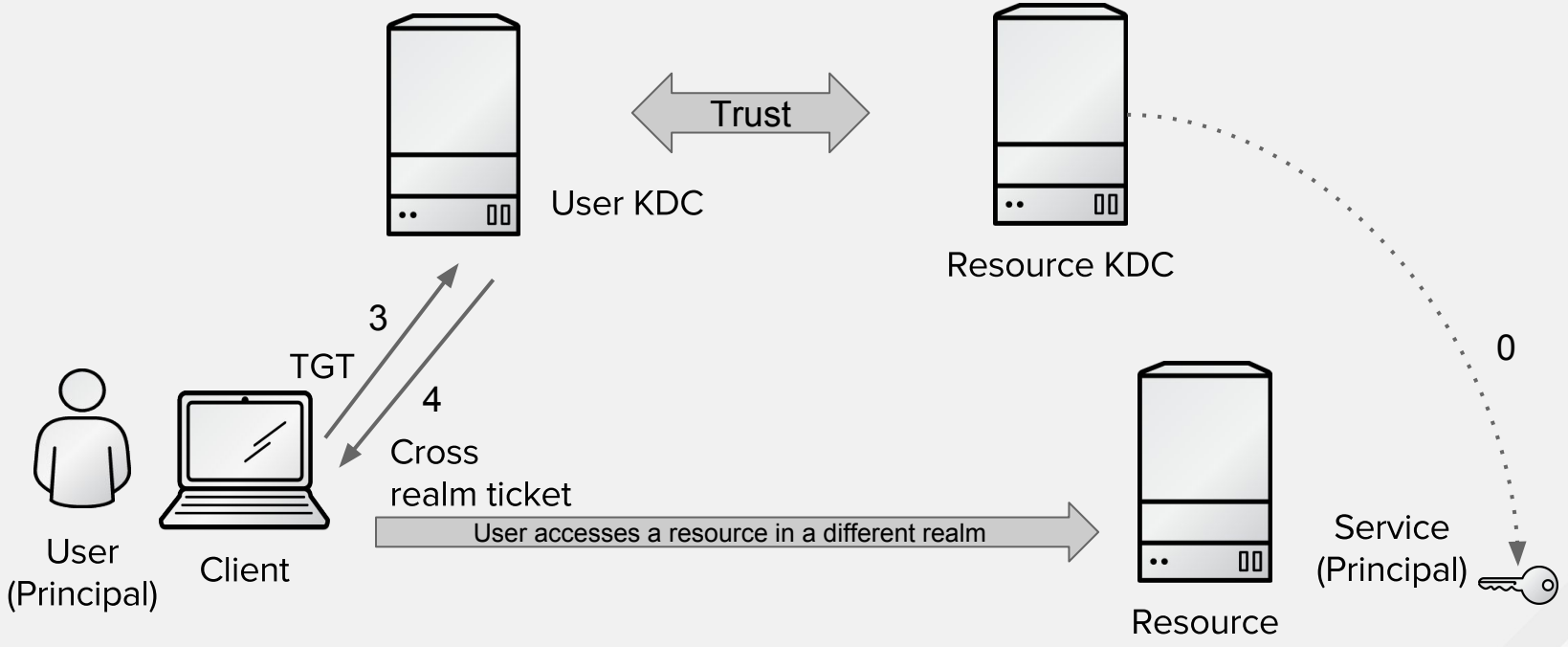

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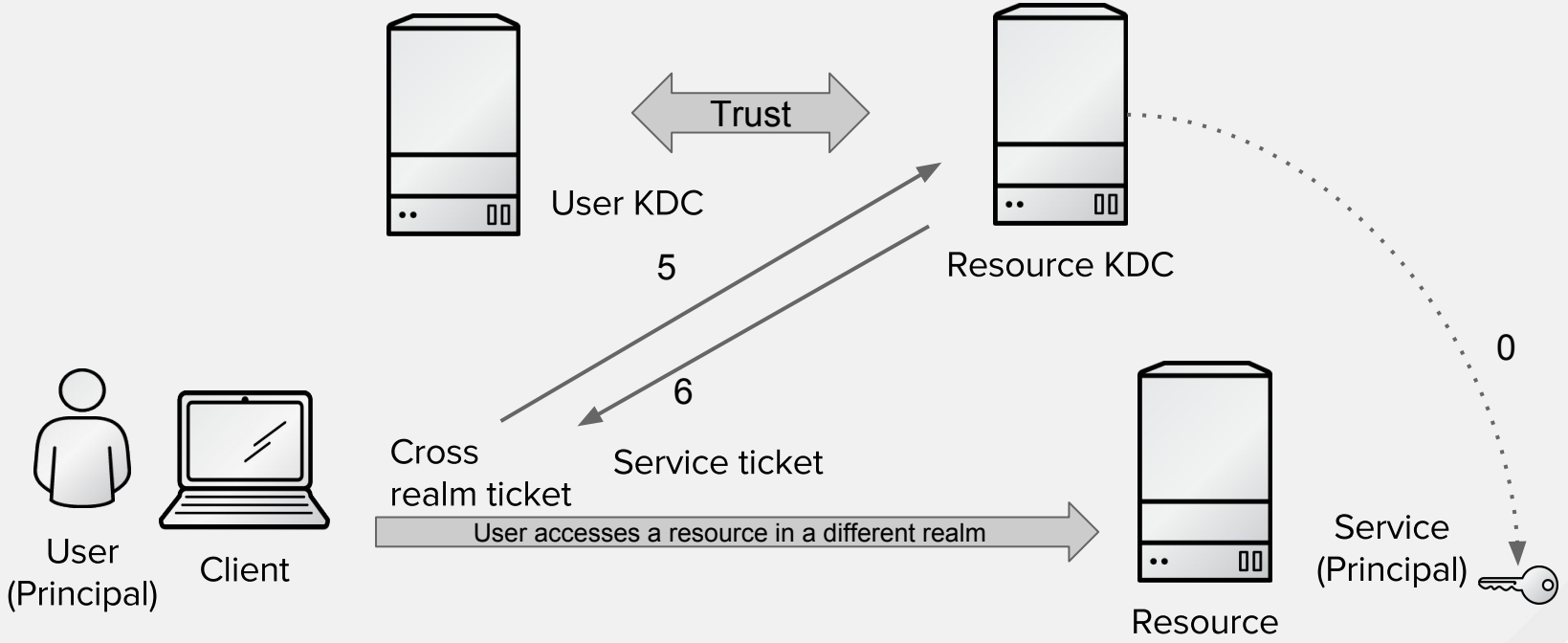

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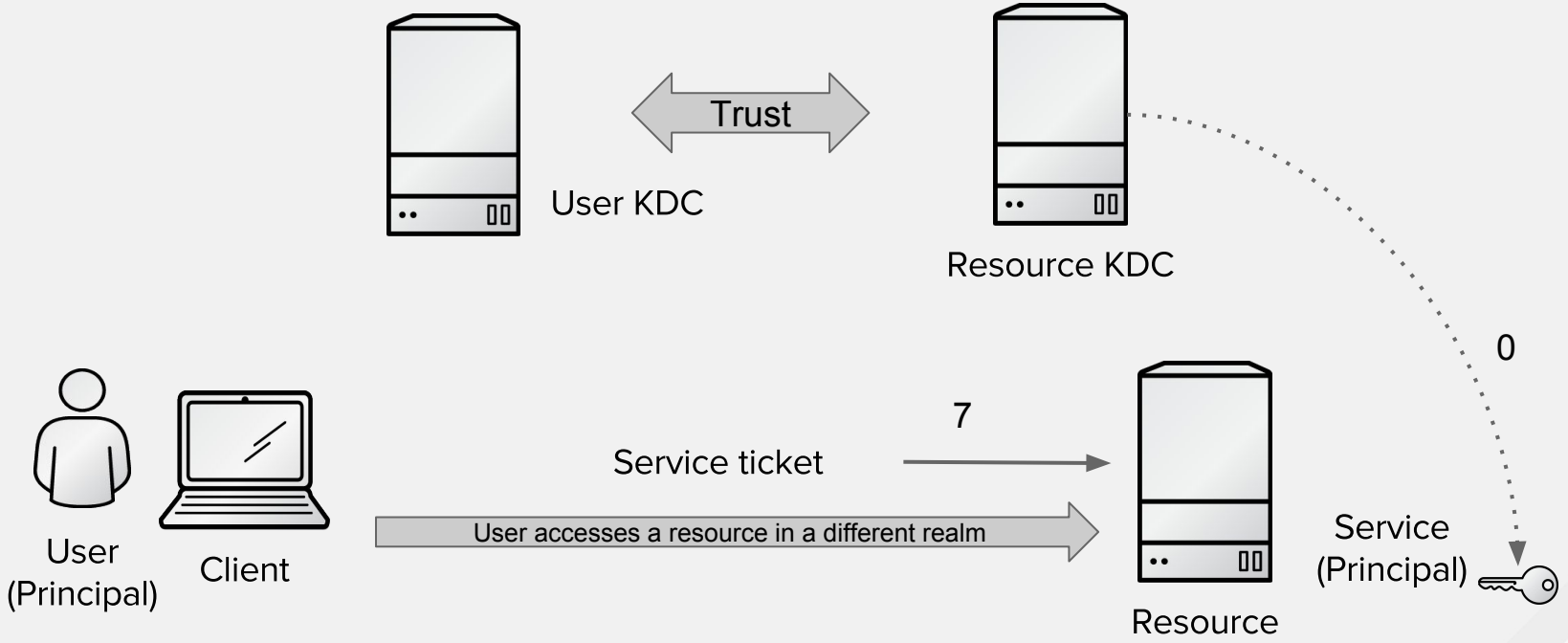

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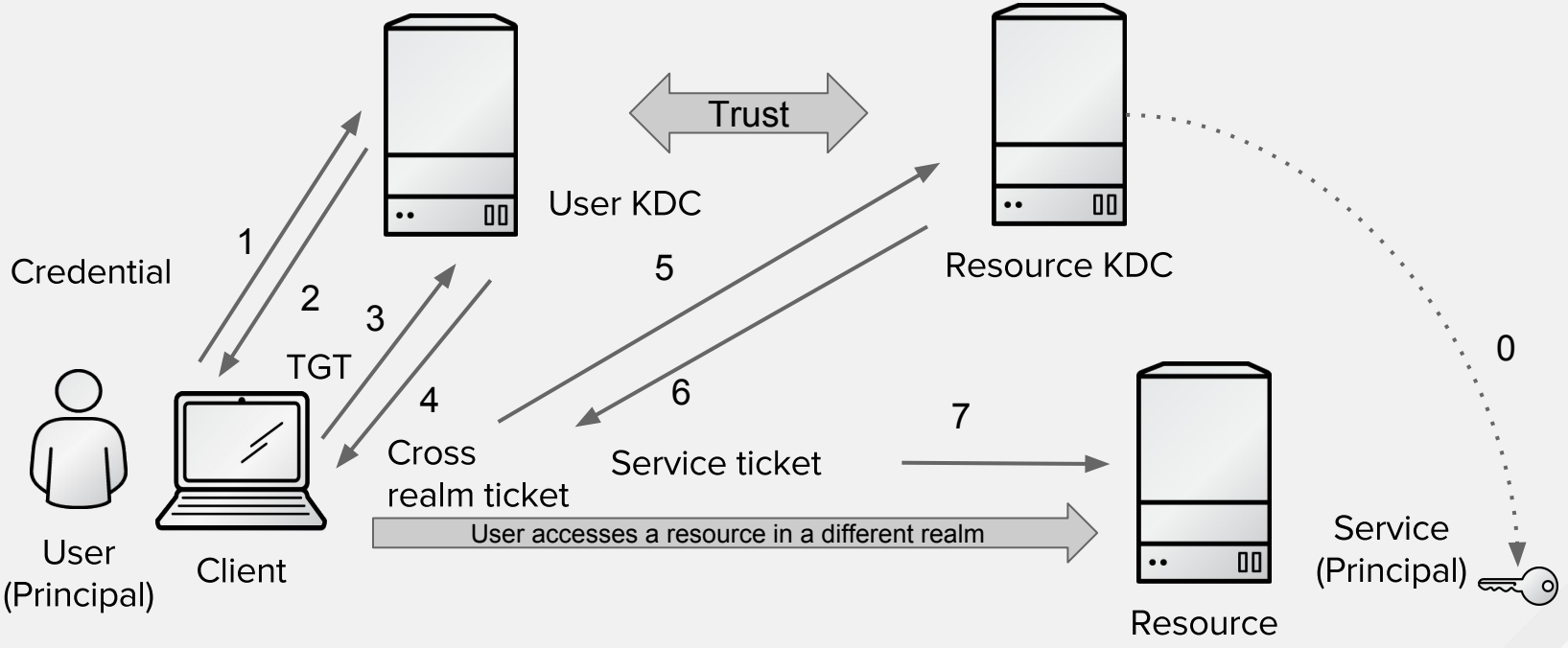

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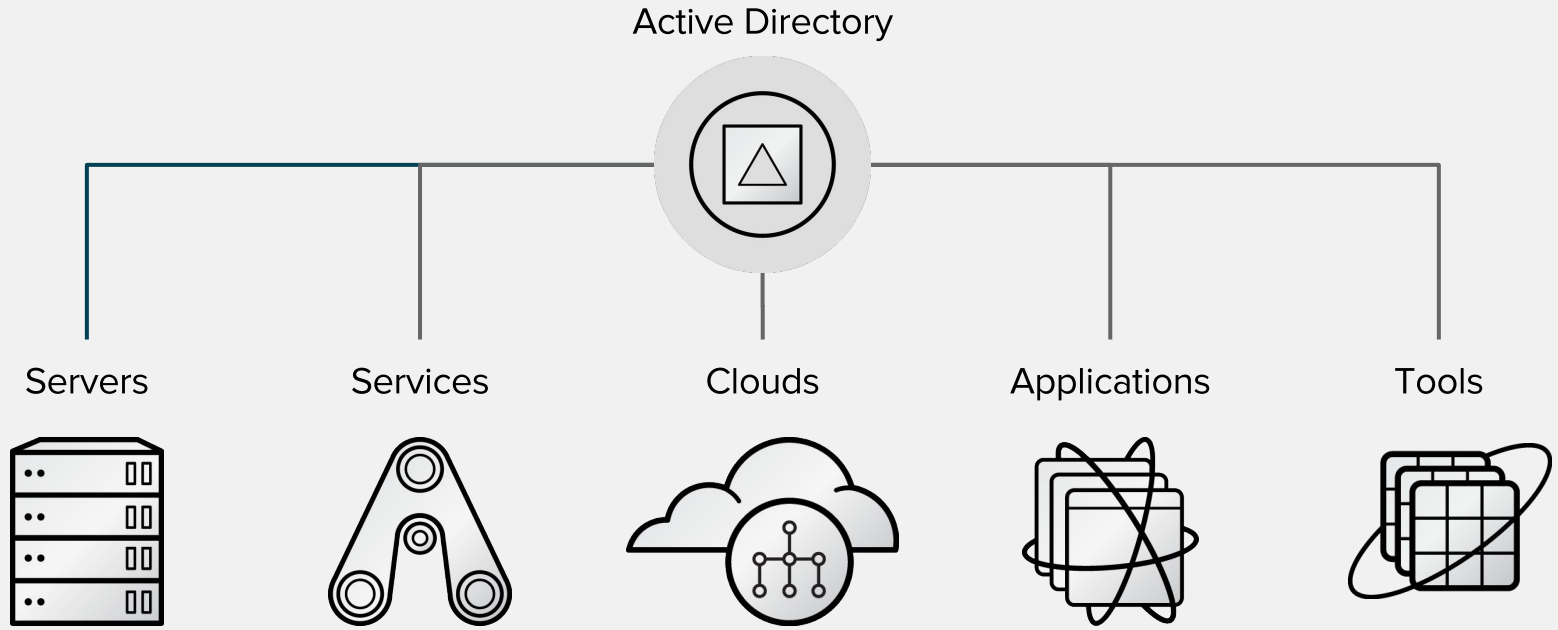
Active Directory Integration

Modern Identity Model

Active Directory based solution



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Active Directory Integration

Aspects of Integration

- Authentication
  - User logs into a Linux system or application/service, how is he authenticated?
- Identity lookup
  - How system/application/service knows about the right accounts?
  - How AD accounts are mapped to POSIX?
- Name resolution and service discovery
  - How system/service/application knows where is its authentication and identity server?
- Policy management
  - How other identity related policies are managed on the system?
  - How access control is determined for service or application?

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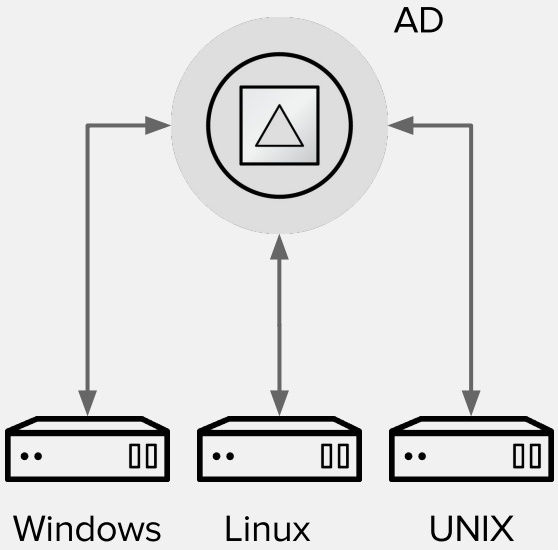
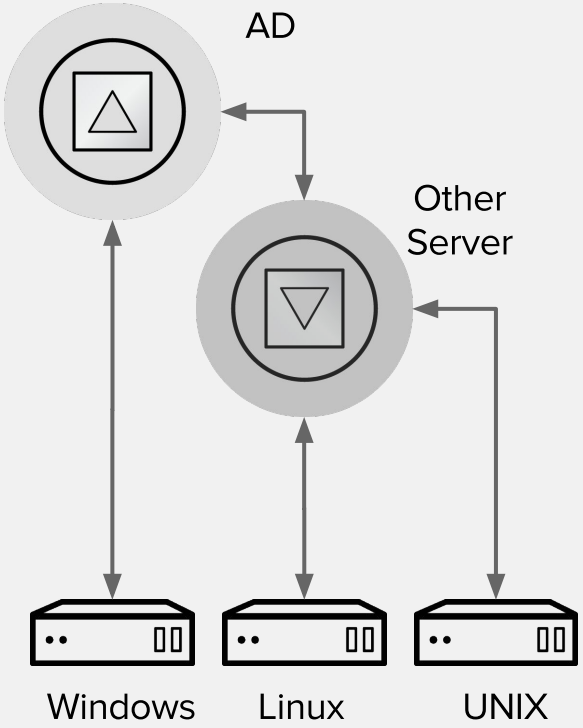
Connecting Systems

Integration Options





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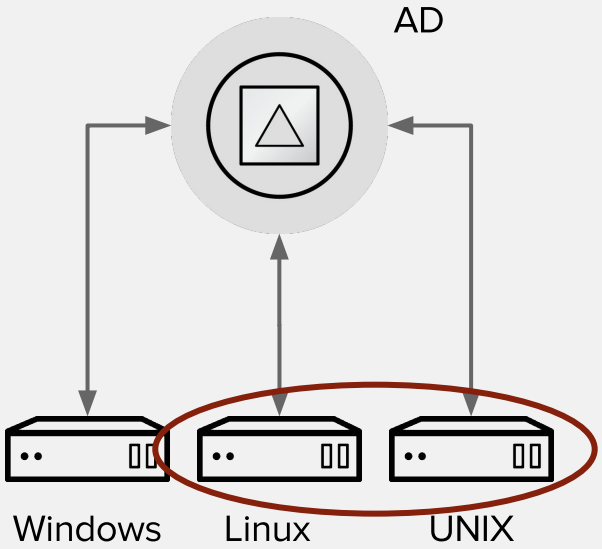
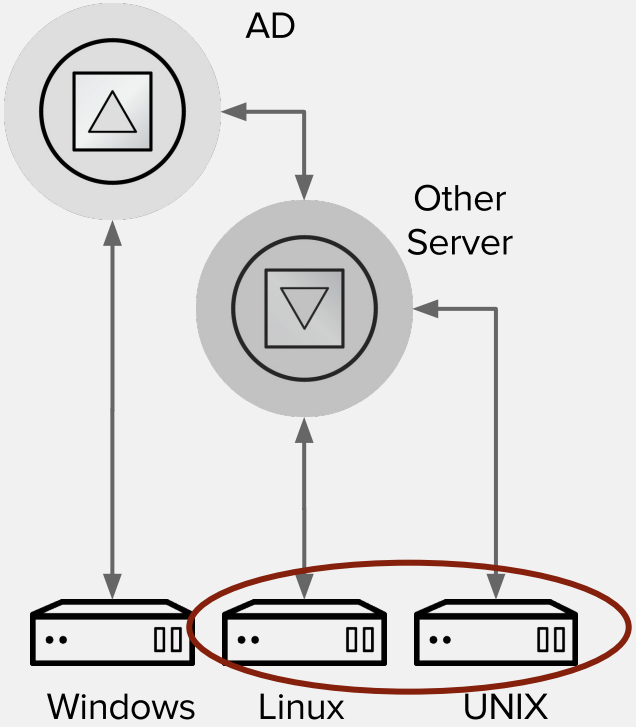
Connecting Systems

Focus of the presentation





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Integration Concerns

Questions to ask

- How can I provide centralized authentication?
- Can I define access control to hosts without copying configuration files?
- Can I manage SSH keys for users and hosts?
- Can I provide centralized SUDO, automount, SELinux user mappings?
- Is there a cost effective solution that provides strong authentication using OTP?
- Can I provide a smooth SSO experience for my users inside the enterprise?
- How can I integrate my applications into the same identity space?
- How to address Active Directory interoperability challenges?
- ...

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Direct Integration Options

Outline

- 3rd party
- Legacy (pam_krb5/pam_ldap, nss_ldap, nslcd)
- Traditional - winbind
- Contemporary - SSSD (with realmd)

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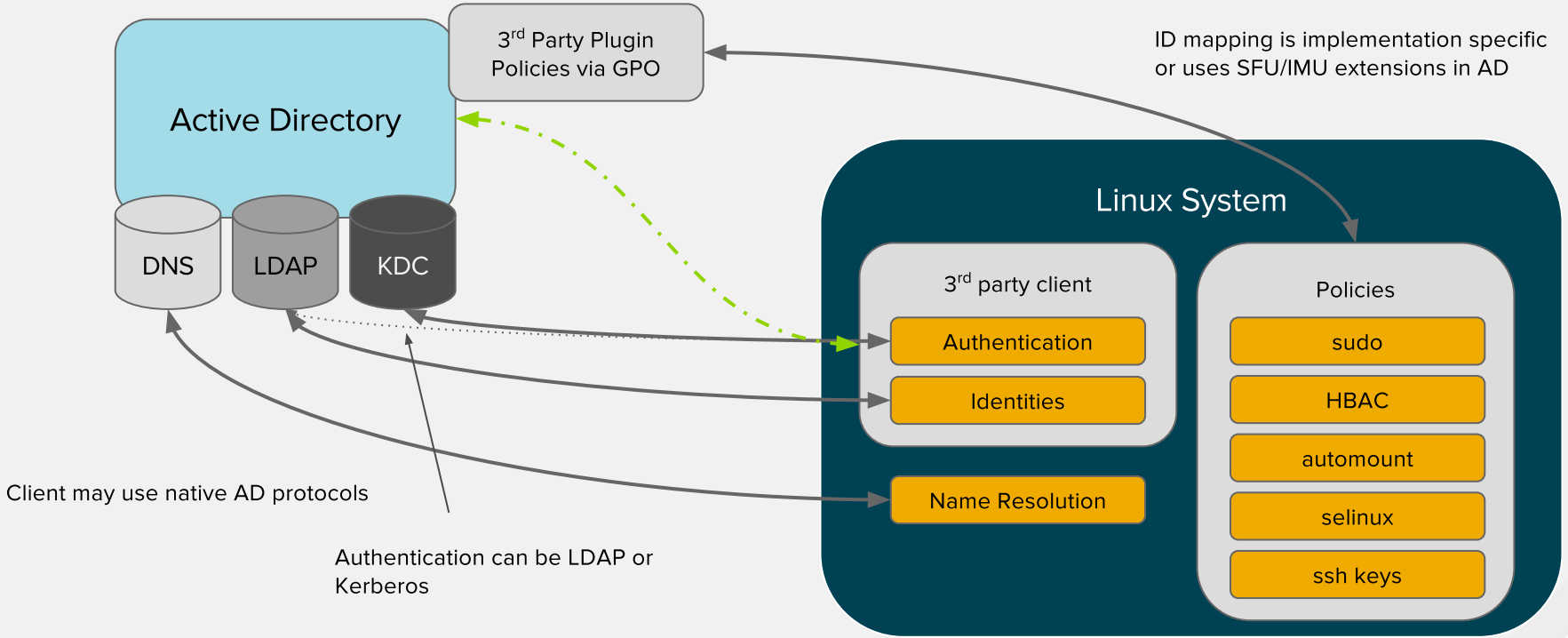
Third Party Direct Integration



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Third Party Direct Integration

Pros and Cons

- Pros
  - Everything is managed in one place including policies
  - SSO can be accomplished via Kerberos
- Cons
  - Requires third party vendor
  - Extra cost per system (adds up)
  - Limits UNIX/Linux environment independence
  - Requires software on AD side
  - OTP support unclear (Azure)

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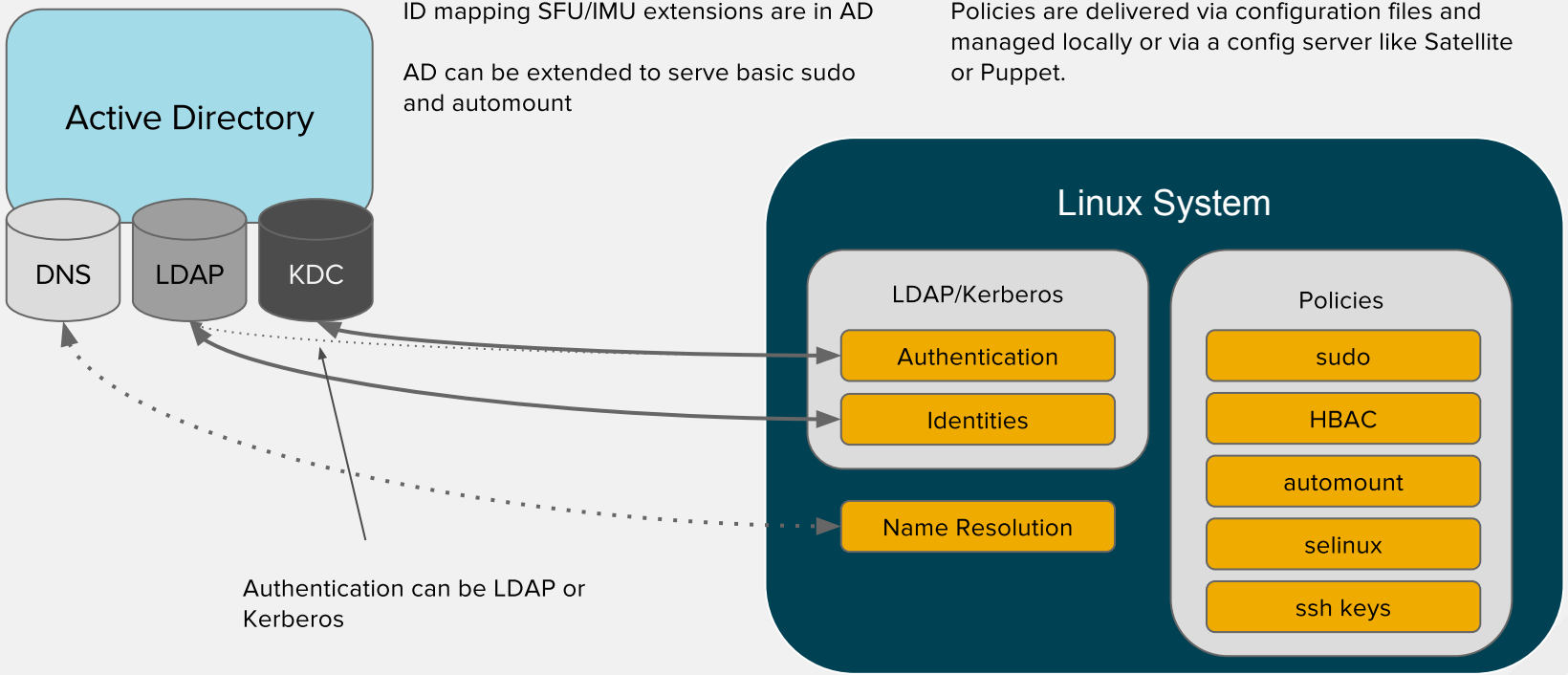
Legacy Direct Integration

ID mapping SFU/IMU extensions are in AD

AD can be extended to serve basic sudo and automount

Policies are delivered via configuration files and managed locally or via a config server like Satellite or Puppet.



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Legacy Direct Integration

Pros and Cons

- Pros:
  - Free
  - No third party vendor is needed
  - Intuitive
  - LDAP OTP authentication in Azure (have not tried)
  - Available on UNIXes
- Cons:
  - Requires SFU/IMU AD extension (which are deprecated as of fall 2014)
  - Policies are not centrally managed
  - Hard to configure securely
  - No SSO with OTP

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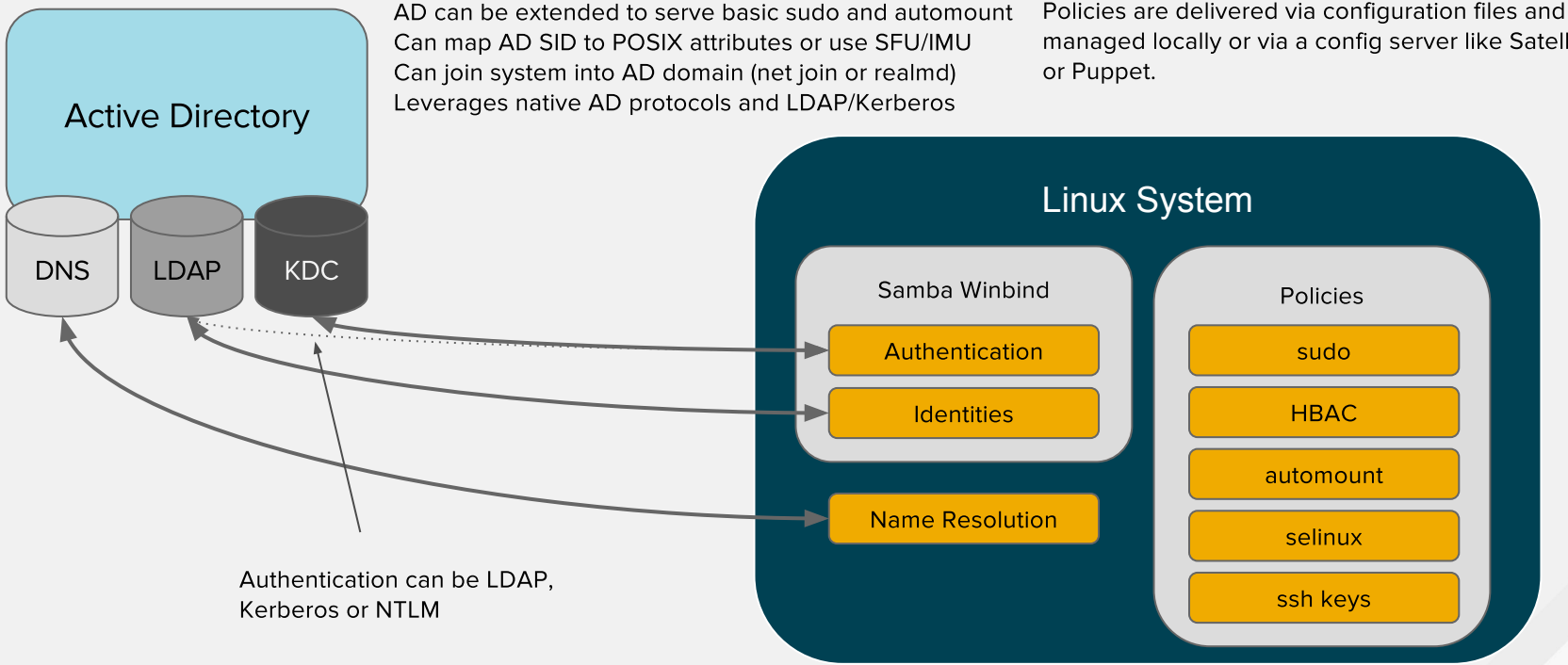
Traditional Direct Integration

AD can be extended to serve basic sudo and automount
Can map AD SID to POSIX attributes or use SFU/IMU
Can join system into AD domain (net join or realmd)
Leverages native AD protocols and LDAP/Kerberos

Policies are delivered via configuration files and managed locally or via a config server like Satellite or Puppet.



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Traditional Direct Integration

Pros and Cons

- Pros:
  - Well known
  - Does not require third party
  - Does not require SFU/IMU
  - Supports trusted domains
  - Supports CIFS client and Samba FS integration
- Cons:
  - Can connect only to AD and very MSFT focused
  - Has some perceived stability issues
  - Policies are not centrally managed
  - No OTP support

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SSSD

Introduction

- SSSD = System Security Services Daemon
- SSSD is a service used to retrieve information from a central identity management system.
- SSSD connects a Linux system to a central identity store:
  - Active Directory
  - FreeIPA
  - Any other directory server
- Provides authentication and access control
- Top technology in the evolution chain of the client side IdM components

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SSSD

Capabilities

- Multiple parallel sources of identity and authentication – domains
- All information is cached locally for offline use
  - Remote data center use case
  - Laptop or branch office system use case
- Advanced features for:
  - FreeIPA integration
  - AD integration

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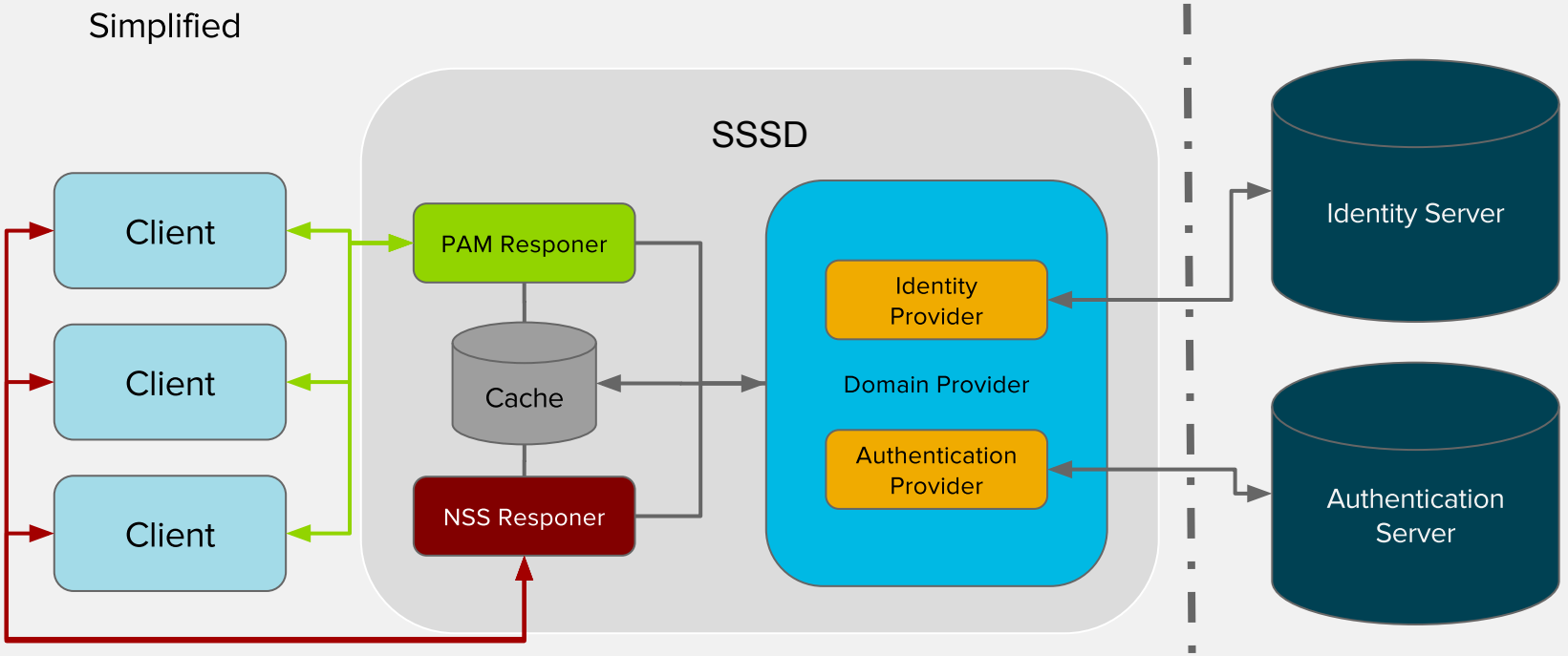
SSSD Architecture

Simplified



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SSSD

Why?

- Supports everything that previous UNIX solutions support and more
- Brings architecture to the next level
- Supports multiple sources – domains
- Supports IdM specific features
- Supports trusts between AD and IdM
- Has a feature parity with winbind in core areas and surpasses in some

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Realmd

Couple words

- Component of Linux
- Main goal is to detect domain environment using DNS (detection)
  - AD
  - FreeIPA
  - Kerberos
- Join system to the domain (using SSSD or Winbind)
- Do it in one command or click
- Availability: command line, D-BUS interface, system installer, desktop

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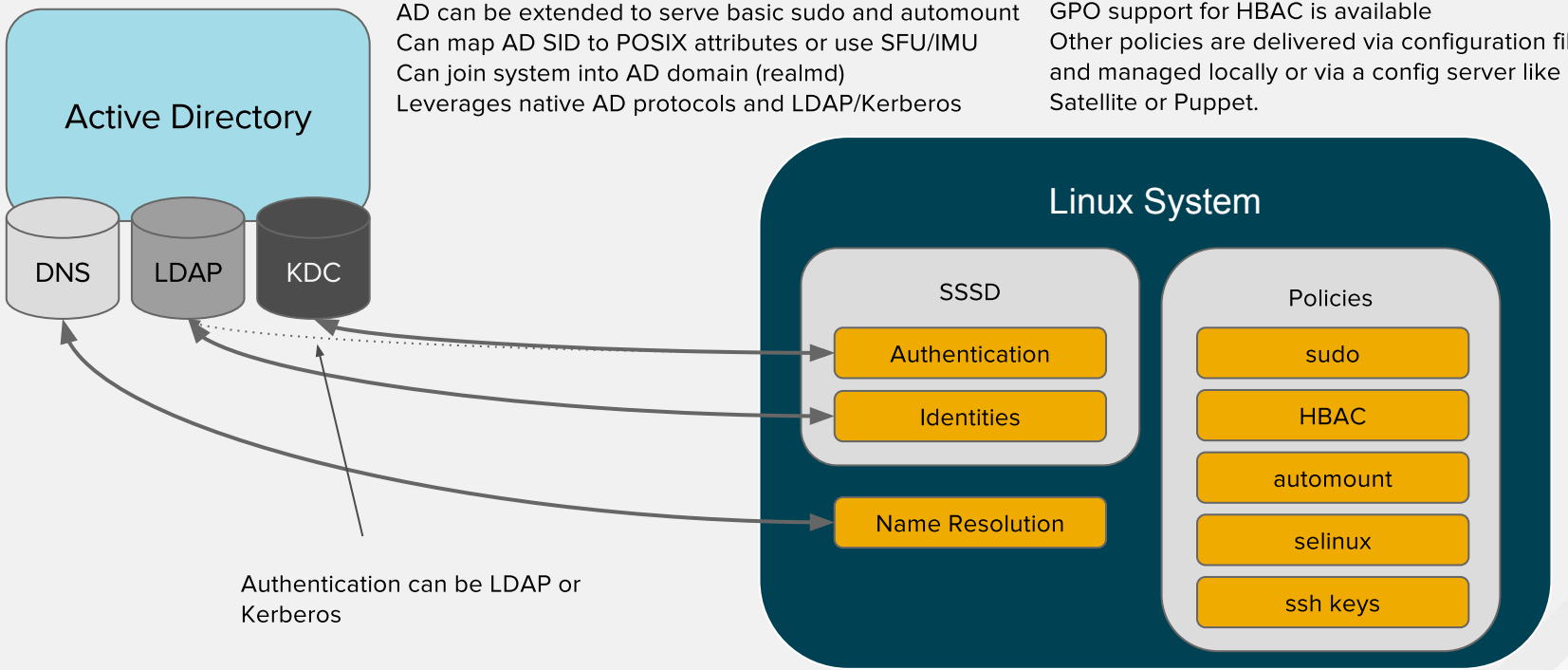
SSSD Based Direct Integration

AD can be extended to serve basic sudo and automount
Can map AD SID to POSIX attributes or use SFU/IMU
Can join system into AD domain (realmd)
Leverages native AD protocols and LDAP/Kerberos

GPO support for HBAC is available
Other policies are delivered via configuration files and managed locally or via a config server like Satellite or Puppet.



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SSSD Based Direct Integration

Pros and Cons

- Pros:
  - Does not require SFU/IMU but can use them
  - Can be used with different identity sources
  - Support transitive trusts in AD domains and forest trusts with FreeIPA
  - Supports CIFS client and Samba FS integration
  - GPO for Windows based HBAC
- Cons:
  - No NTLM support, no support for AD forest trusts (yet)
  - No SSO with OTP
  - Not all policies are centrally managed

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Direct Integration

Option Summary

Please read my blog :-)

http://rhelblog.redhat.com/author/dpalsecam/

Comparison:

http://rhelblog.redhat.com/2015/02/04/overview-of-direct-integration-options/

redhat.

Direct Integration

Bottom line

- SSSD is the way to go
- Winbind is the fallback option:
  - if you rely on NTLM (please do not, it is very insecure)
  - If you have multiple forests and need users from different forests to access the Linux system
- Policy management is still not fully central
- Might require deprecated extensions on the AD side
- Per system CALs add to cost
- Linux/UNIX administrators do not have control over the environment

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FreeIPA/IdM

FreeIPA/IdM

Introduction

- IdM – Identity Management in Red Hat Enterprise Linux
- Based on FreeIPA open source technology
- IPA stands for Identity, Policy, Audit
  - So far we have focused on identities and related policies
  - Audit is coming but it is bigger than FreeIPA

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FreeIPA/IdM

Problems it solves

- Central management of authentication and identities for Linux clients better than stand - alone LDAP/Kerberos/NIS - based solutions
- Acts as a gateway between the Linux infrastructure and AD environment making infrastructure more manageable and more cost effective

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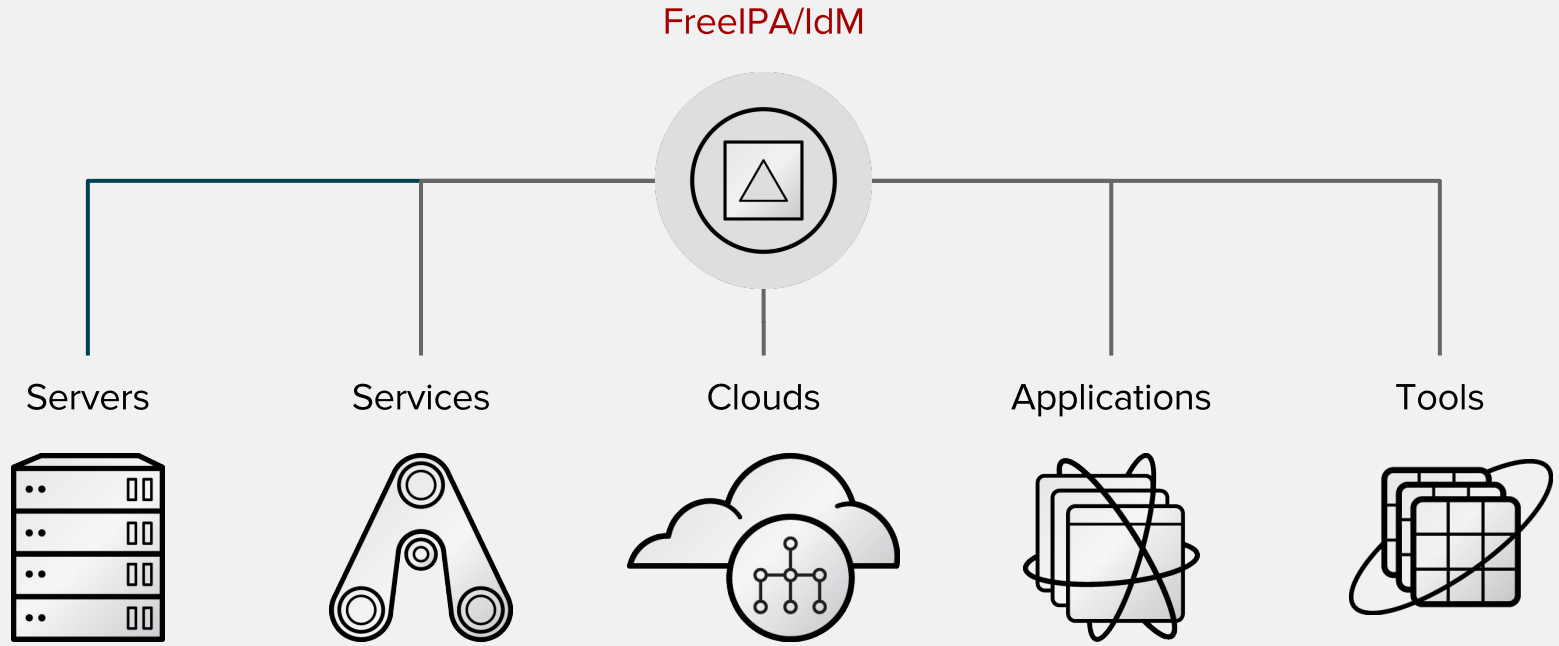
Modern Identity Model

Simplified View



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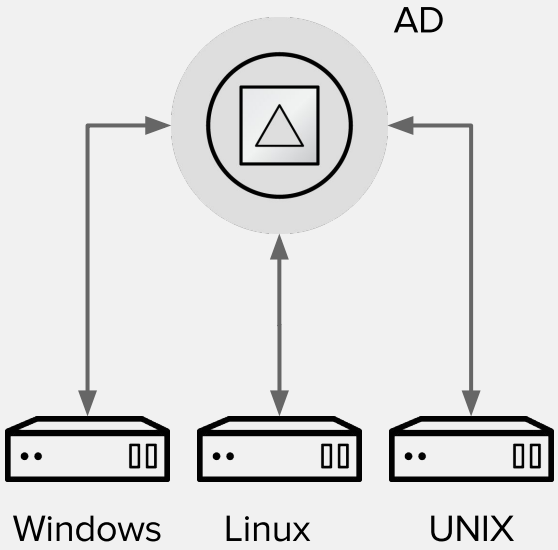
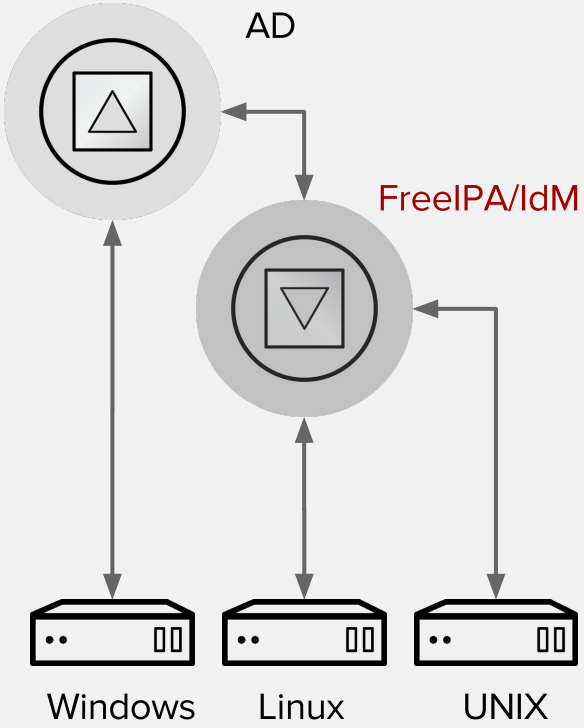
Connecting Systems

Integration Options





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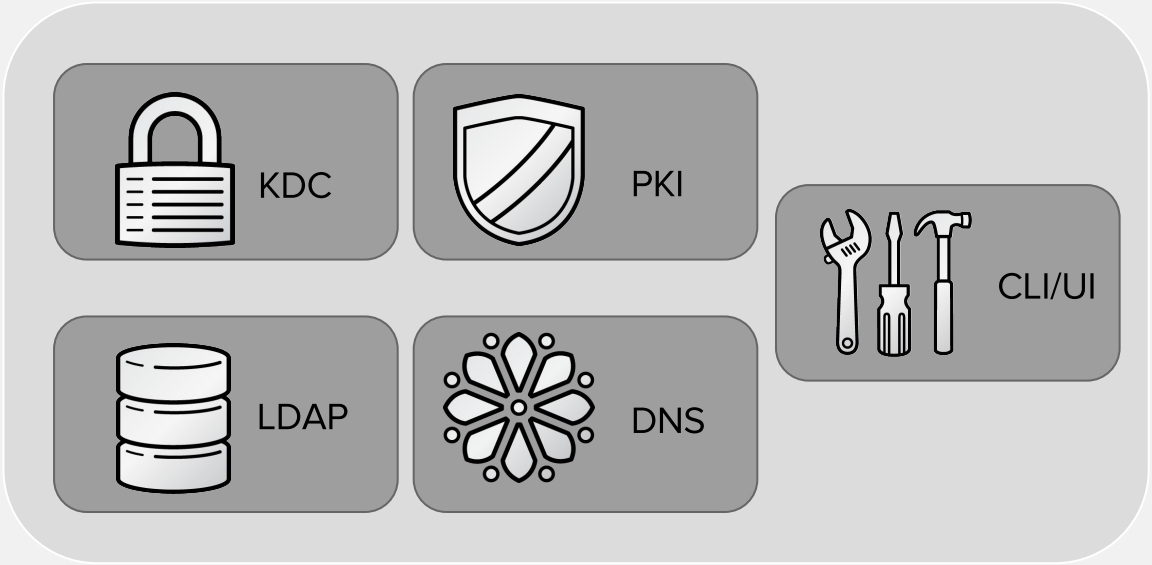
FreeIPA/IdM

High Level Architecture



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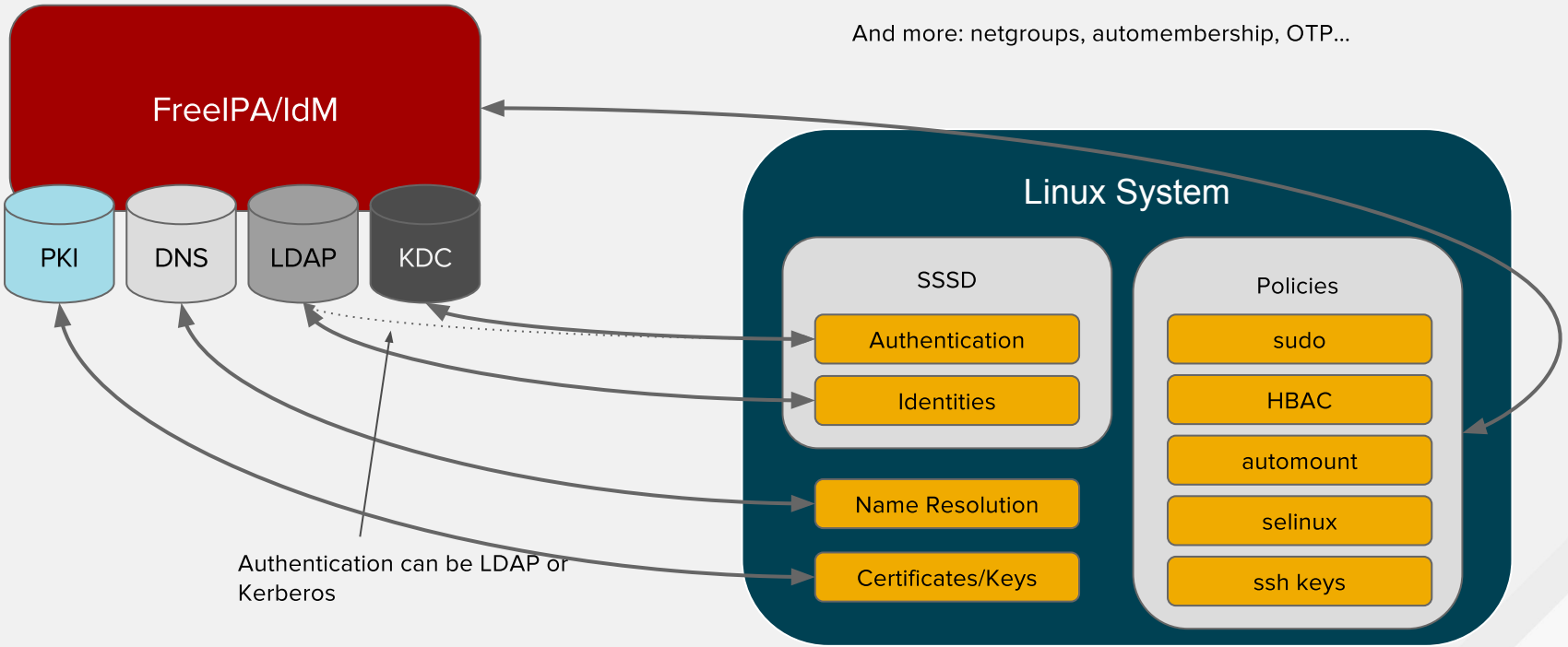
FreeIPA/IdM Integration



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FreeIPA/IdM

Features

- Centralized authentication via Kerberos or LDAP
- Identity management:
  - users, groups, hosts, host groups, netgroups, services
  - user lifecycle management
- Manageability:
  - Simple installation scripts for server and client
  - Rich CLI and web-based user interface
  - Pluggable and extensible framework for UI/CLI
  - Flexible delegation and administrative model
    - Self, delegated, role based; read permissions

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FreeIPA/IdM

Features Continued

- Host-based access control
- Centrally-managed SUDO
- SSH key management
- Group-based password policies
- Automatic management of private groups
- Can act as NIS server for legacy systems
- Painless password migration
- SELinux user mapping
- Auto-membership for hosts and users
- Serving sets of automount maps to different clients
- Different POSIX data and SSH keys for different sets of hosts

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FreeIPA/IdM

Features DNS

- DNS is optional but convenient
- Advantages (automation and security):
  - The SRV records get created automatically
  - Host records get created automatically when hosts are added
  - The clients can update their DNS records in a secure way (GSS-TSIG)
  - The admin can delegate management of the zones to whomever he likes
  - Built in DNSSEC support (planned as Tech Preview in RHEL 7.2)
- Disadvantages:
  - You need to delegate a zone

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FreeIPA/IdM

More Features

- Replication:
  - Supports multi-server deployment based on the multi-master replication (up to 20 replicas)
  - Recommended deployment 2K-3K clients per replica
  - Details depend on the number of data centers and their geo- location
- 2FA
  - Native HOTP/TOTP support with FreeOTP and Yubikey
  - Proxied 2FA authentication over RADIUS for other solutions
  - 2FA for AD users (in works)
- Backup and Restore
- Compatibility with broad set of clients (LINUX/UNIX)

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FreeIPA/IdM

Features PKI

- CA related capabilities
  - Certificate provisioning for users (new), hosts and services
  - Multiple certificate profiles
  - Sub CAs (in works)
- CA deployment types
  - CA-less
  - Chained to other CA
  - Self signed root
- Tool to change deployment type and rotate CA keys
  - Flexibility in deploying CAs on different replicas
- Key store (Vault)

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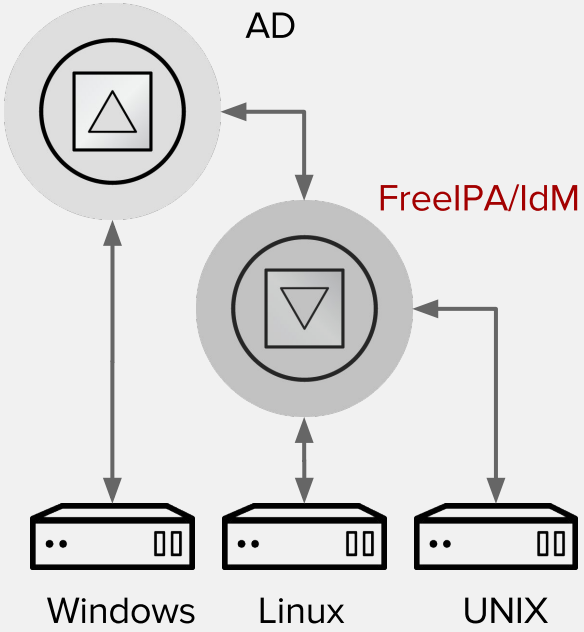
Indirect Integration using FreeIPA/IdM

Indirect Integration

Deep dive



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Integration Paths

Overview

- User and password synchronization (not recommended)
- Cross forest trusts (recommended)

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Synchronization Solution

Overview

- LDAP level synchronization
- AD is the authoritative source - one way sync
- No group synchronization, only users
- Only one domain can be synchronized
- Single point of failure - sync happens only on one replica
- Limited set of attributes is replicated
- Passwords need to captured and synced
    - Requires a plugin on every AD DC
    - Mismatch of password policies can lead to strange errors

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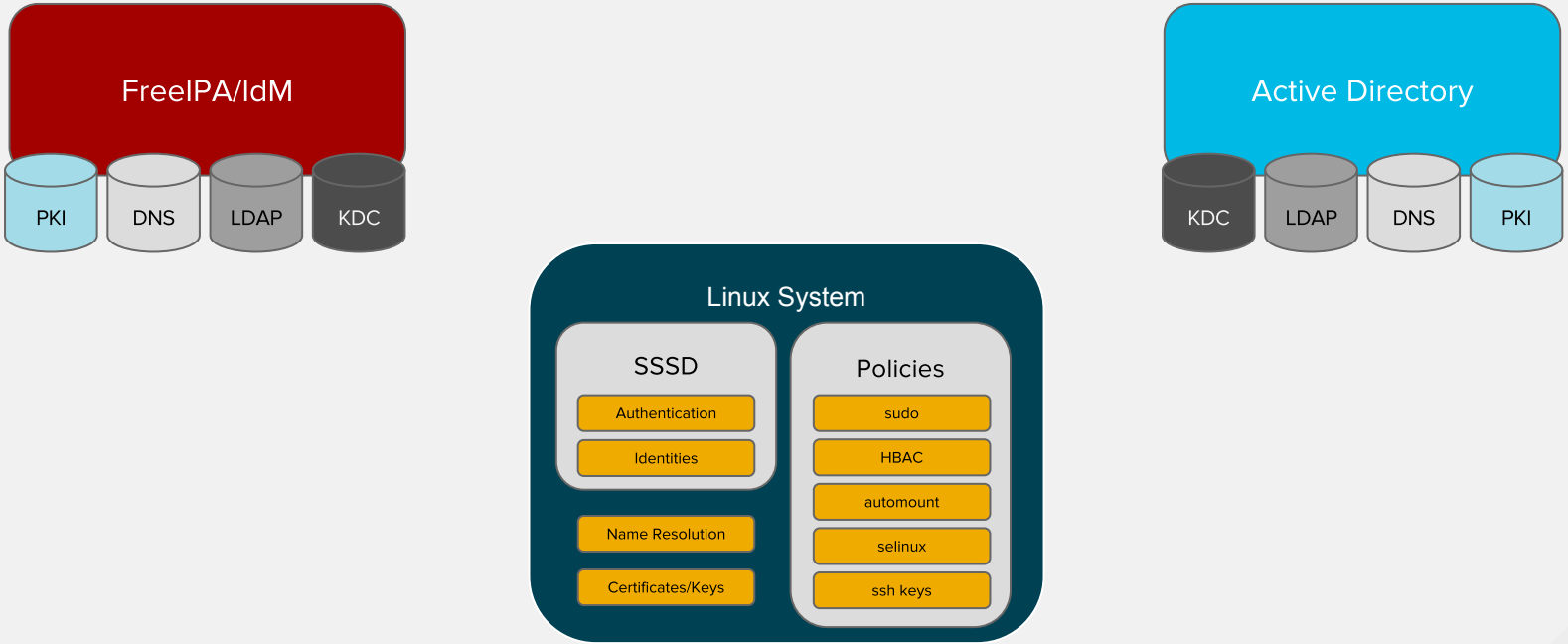
FreeIPA/IdM AD Integration with Trust



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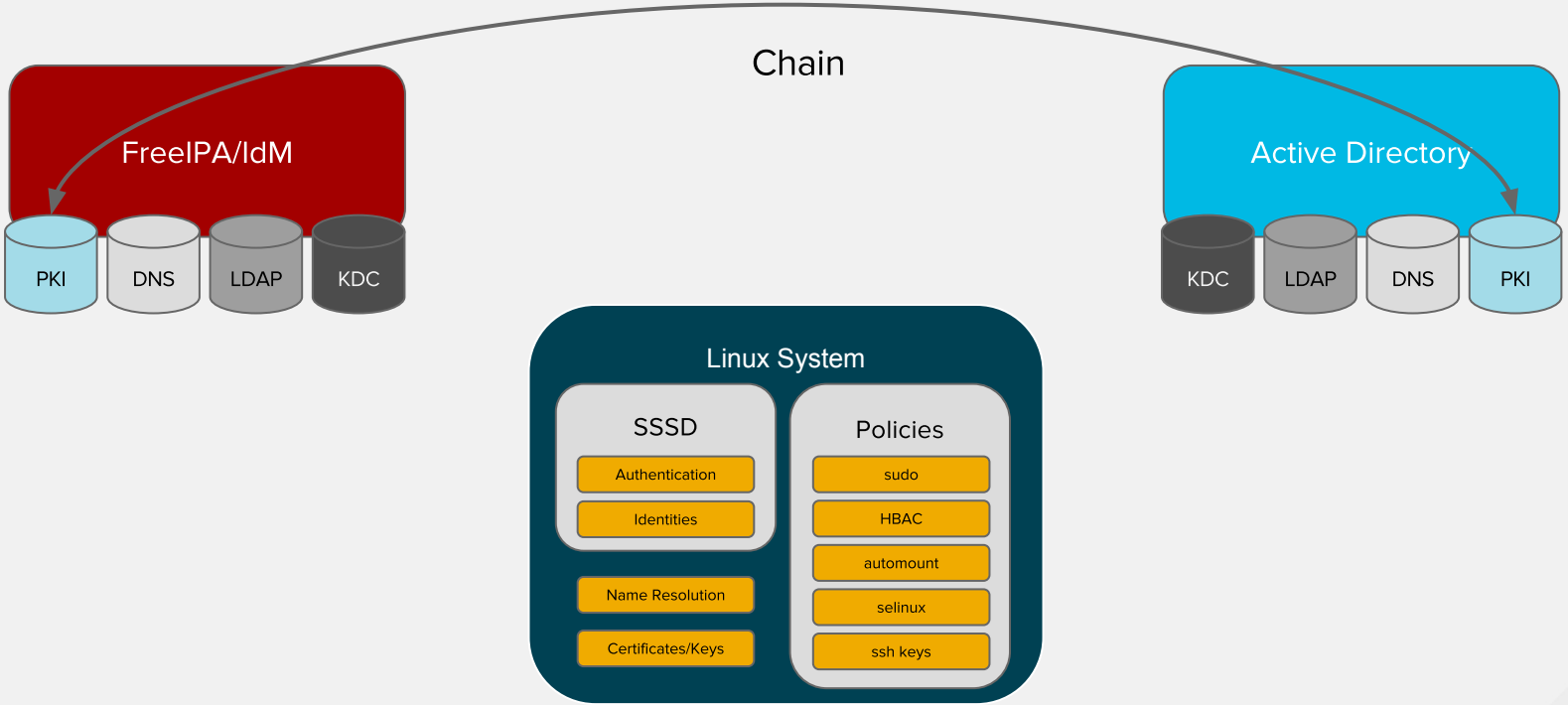
FreeIPA/IdM AD Integration with Trust



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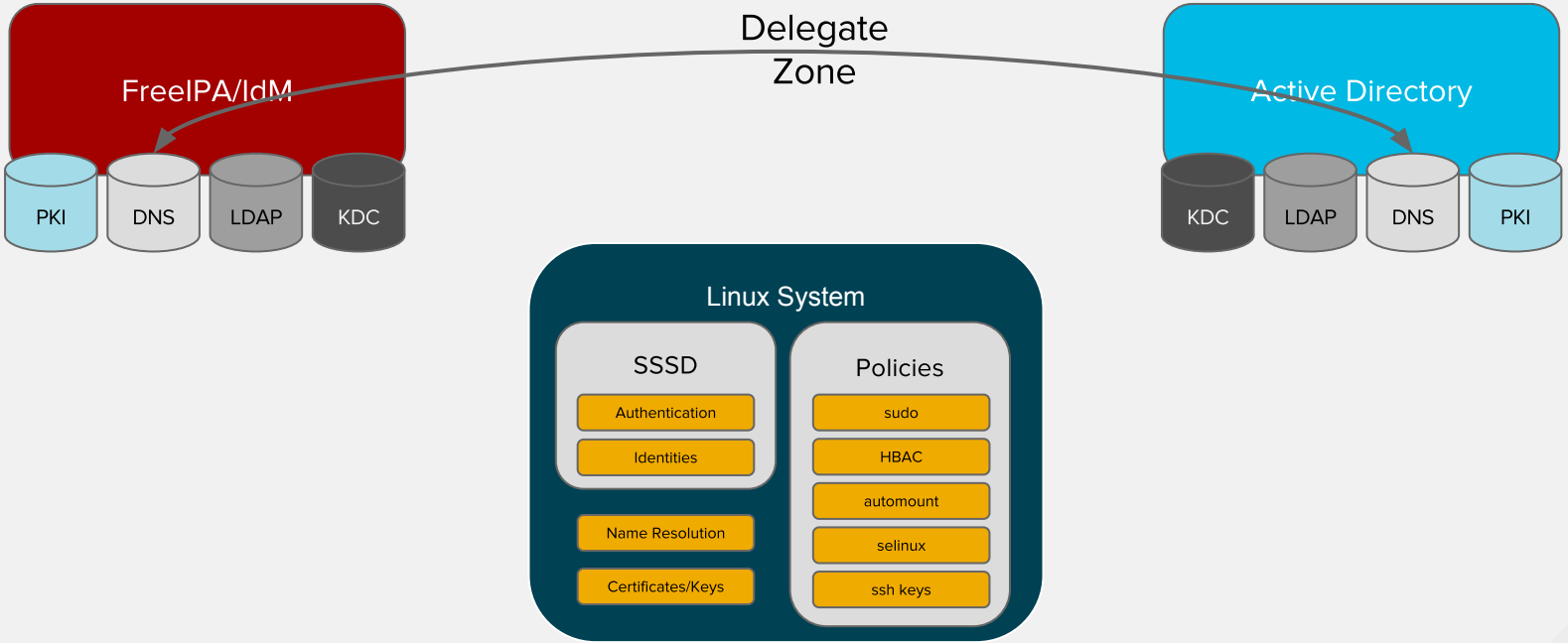
FreeIPA/IdM AD Integration with Trust



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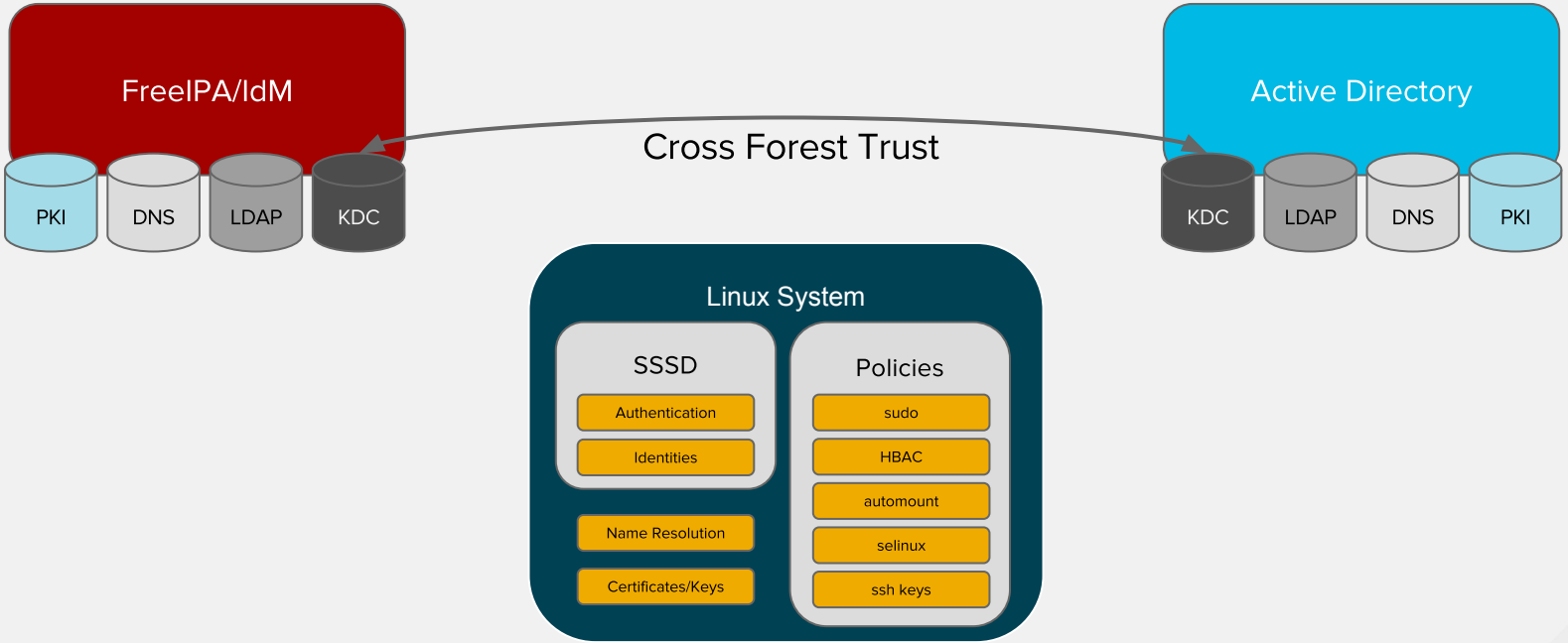
FreeIPA/IdM AD Integration with Trust



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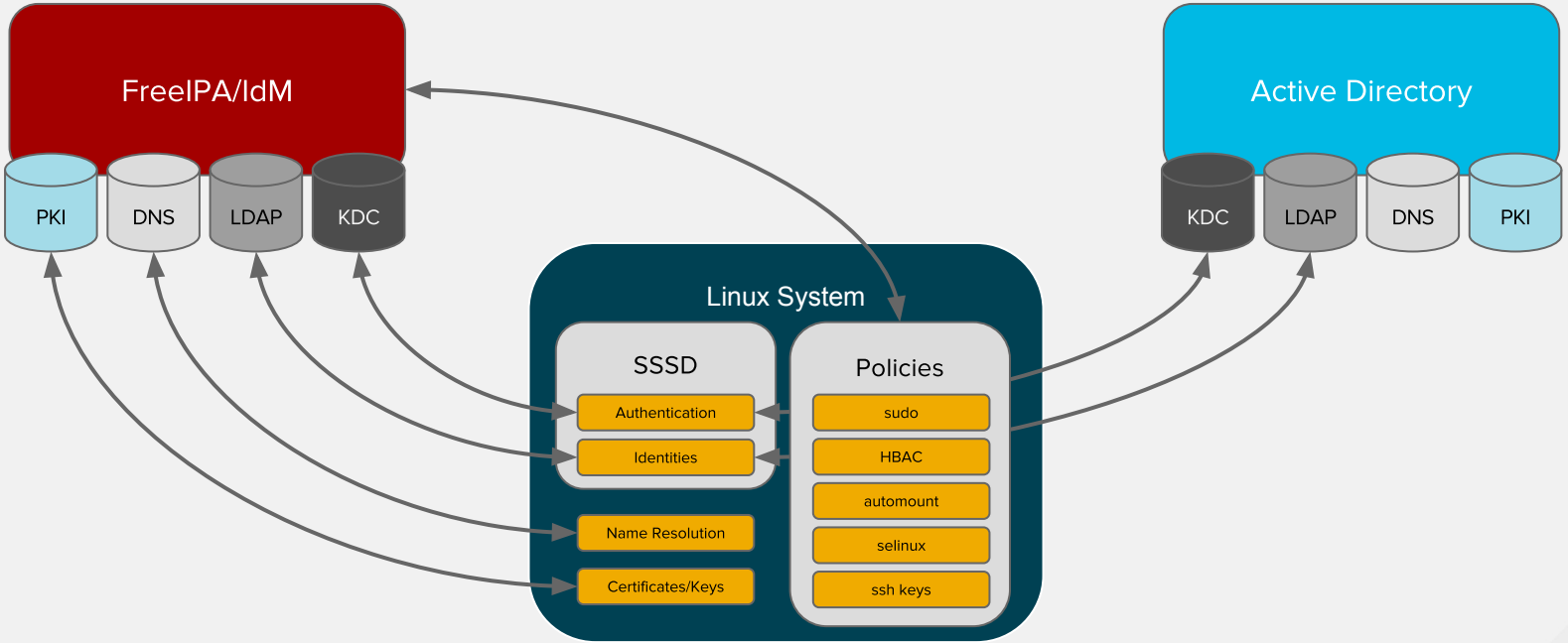
FreeIPA/IdM AD Integration with Trust



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Trust Based Solution

Pros and Cons

- Pros:
  - Reduces cost – no CALs or 3rd party
  - Policies are centrally managed
  - Gives control to Linux admins
  - Enabled independent growth of the Linux environment
  - No synchronization required
  - Authentication happens in AD
- Requirement:
  - Proper DNS setup

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User Mapping

Details

- Can leverage SFU/IMU for POSIX (brown field)
- Can do dynamic mapping of the SIDs to UIDs & GIDs (green field)
- Static override with ID views

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Trust

Details

- Two-way and one-way trust (FreeIPA trusts AD)
  - AD/Samba DC trusting FreeIPA is on the roadmap
- Trust agents (different behavior of different replicas)
- Migration from the sync to trust

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Application Integration
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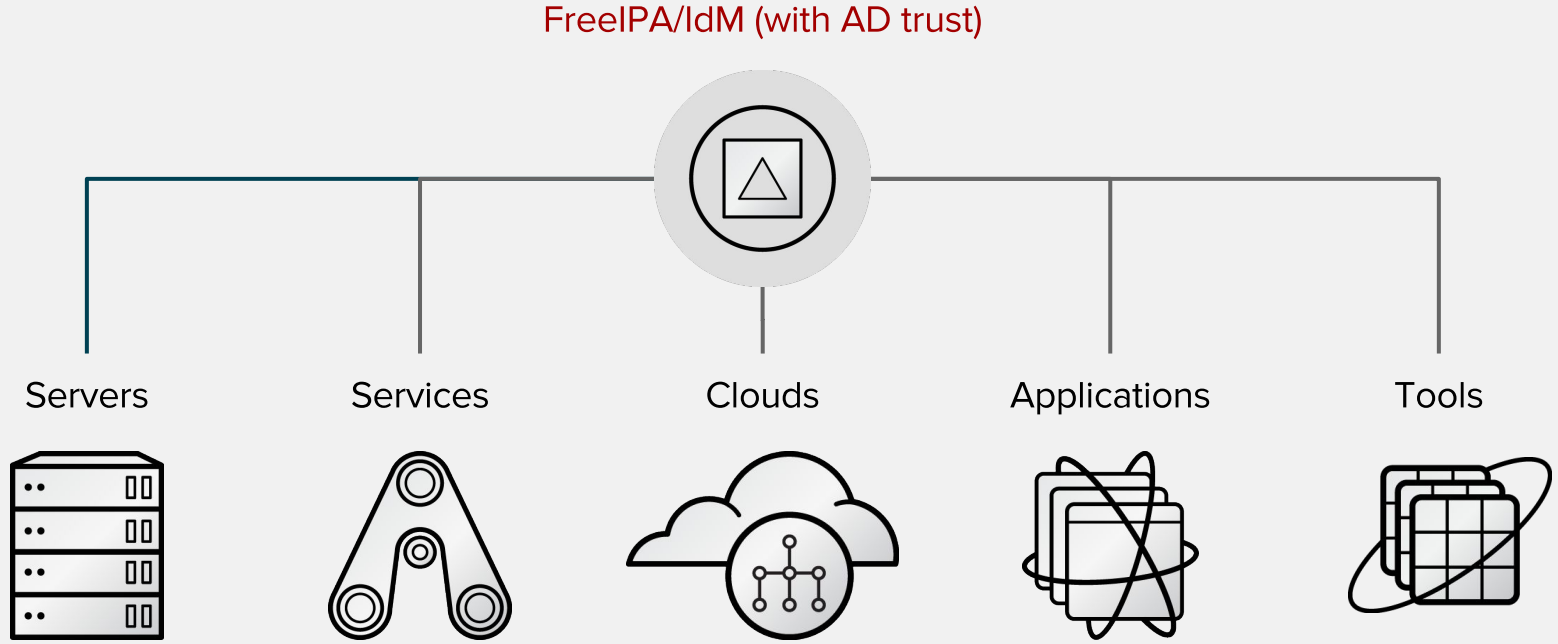
Modern Identity Model

Simplified View



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Application Integration

Current situation

- Applications are usually integrated using LDAP
- This approach has challenges:
  - Types of users
  - User sources
  - Connections to those sources
  - Deployment modes

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Types of Users

Overview

- End users:
  - Users coming from the internet (customers)
  - Users that are a part of the enterprise (internal customers)
  - Contractors, partners, providers, suppliers...
- Power users:
  - Enterprise sysadmins
  - Service provider
  - IT services subcontractor

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User Sources

Overview

- On Premise:
  - Users/admins come from:
    - Domain controllers (LDAP + Kerberos + more):
      - Active Directory, FreeIPA/IdM
    - LDAP directories:
      - 389, OpenLDAP, ApacheDS, SunDS, Oracle OID...
    - Databases
      - SQL, Non-SQL
    - Federation
      - SAML IdP, OpenID, OpenID Connect

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User Sources

Overview continued

- Managed Service (Cloud):
  - End users and some power users - from customer sources
  - Power users (those who manage tenants) - from managed service provider

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Connections to Sources

Overview

- Security of connections
  - Identities, passwords, keys, certs
- Multiples of identity sources in the same environment
  - Different LDAPs, Domains, Forests
- Failover
  - Each directory consists of multiple servers
- Offline situation (connection to all servers lost)

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Deployment Modes

Overview

- Development – simple, no central server
- Demo – emulated users with roles, single box
- POC – using a dummy directory
- Production – all sorts of different identity sources as mentioned above

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Complexity Matrix

Welcome to identity management nightmare!

- Evolution of the application leaves a lot of cruft that is hard to maintain or clean
- Different modes of operation dictate different identity sources
- Different production use cases and requirements create a lot of complexity
- Add compliance requirements and audits…
- One has to be an expert to sort all this out…

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What if?

- Can we offload all this complexity somewhere?

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What if?

- Can we offload all this complexity somewhere?
- How about externalizing the authentication, some access control and collecting identity information for the user?

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What belongs to application and what not?

- Application manages resources and defines roles. Those belong to the application
- Users with properties and group membership come from external sources
- Mapping user groups and properties to roles is the responsibility of the application
- This mapping is independent of the source the user came from

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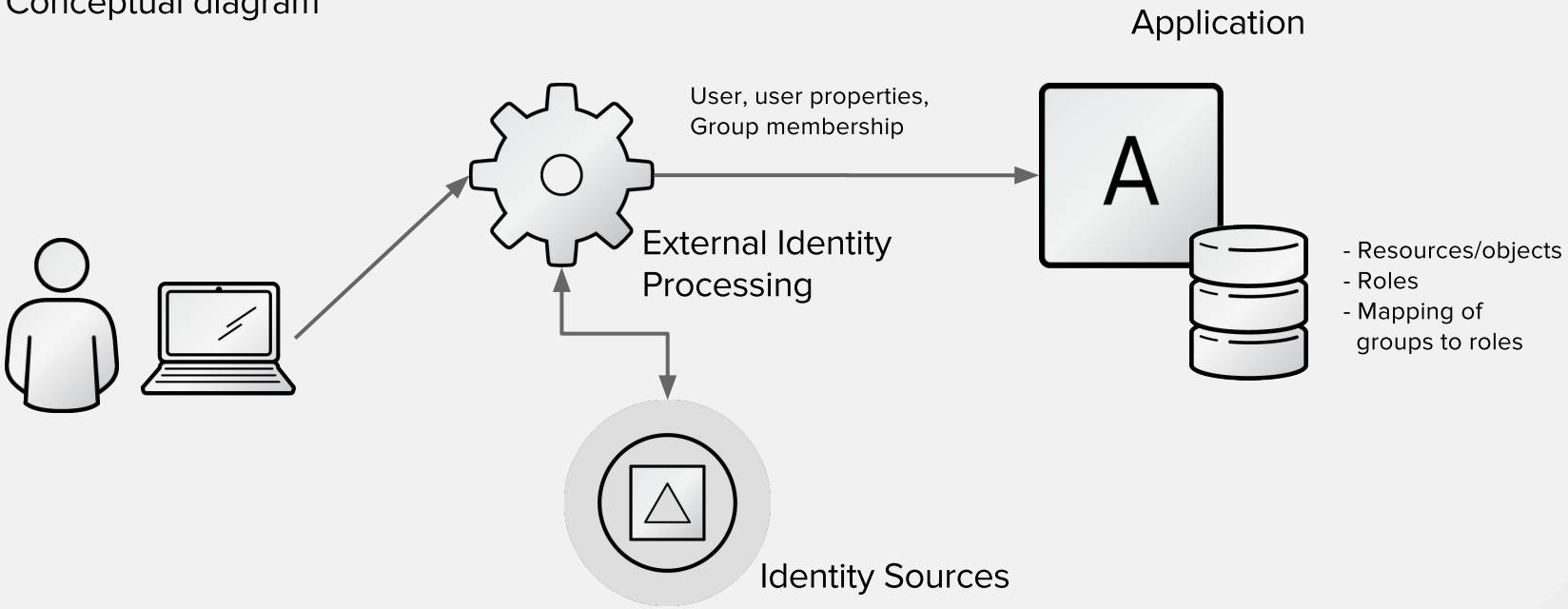
Architecture

Conceptual diagram



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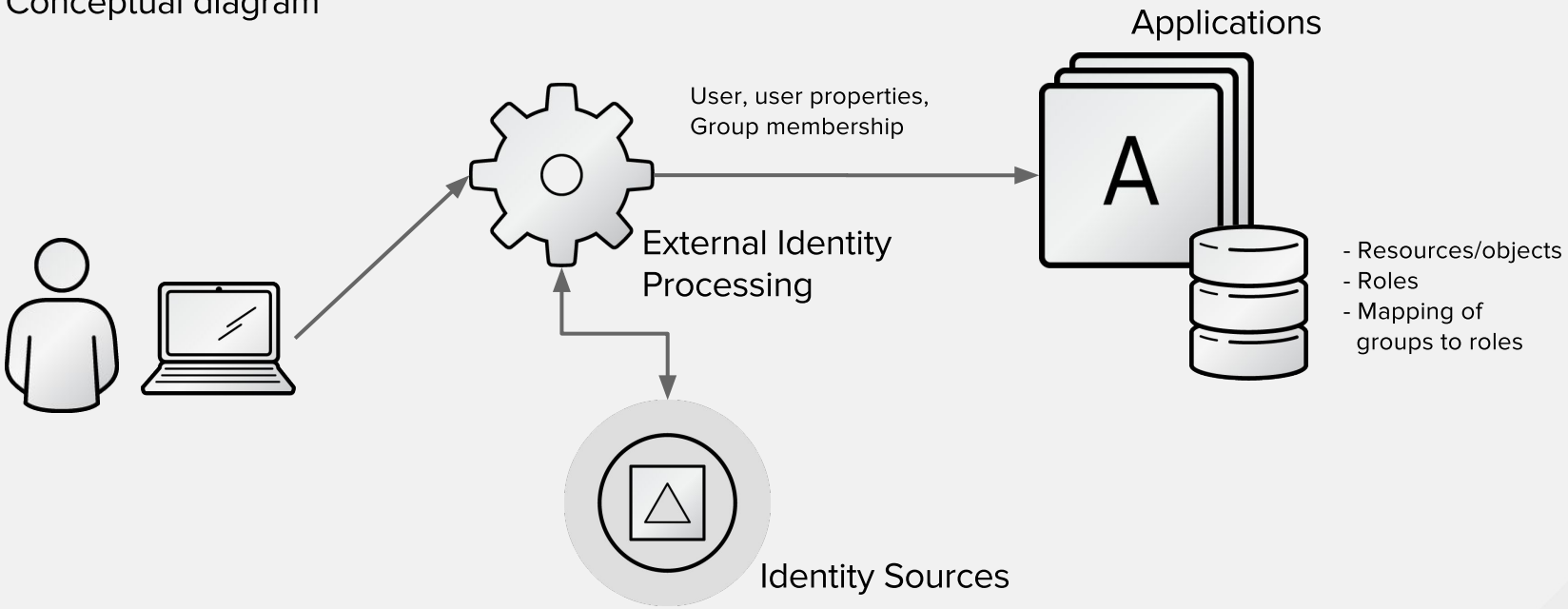
Architecture

Conceptual diagram



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What can be externalized?

Authentication

- AD, FreeIPA (IdM), AD/IdM Trusts, LDAP
- Kerberos GSSAPI
- OTP 2FA
- Certificates
- SAML, OpenID, OpenID connect, Persona

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What can be externalized?

Authorization

- You need to have authorization added in case of:
  - Kerberos GSSAPI case
  - Certificate based authentication

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What can be externalized?

Identity lookup

- Traditional:
  - AD
  - FreeIPA/IdM
  - AD/IdM Trusts
  - LDAP
- Sometimes no identity lookups possible
  - Assertion has all the data

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Apache

Why?

- Apache is a well established web server
- Available on many platforms
- Has a very good pluggable architecture

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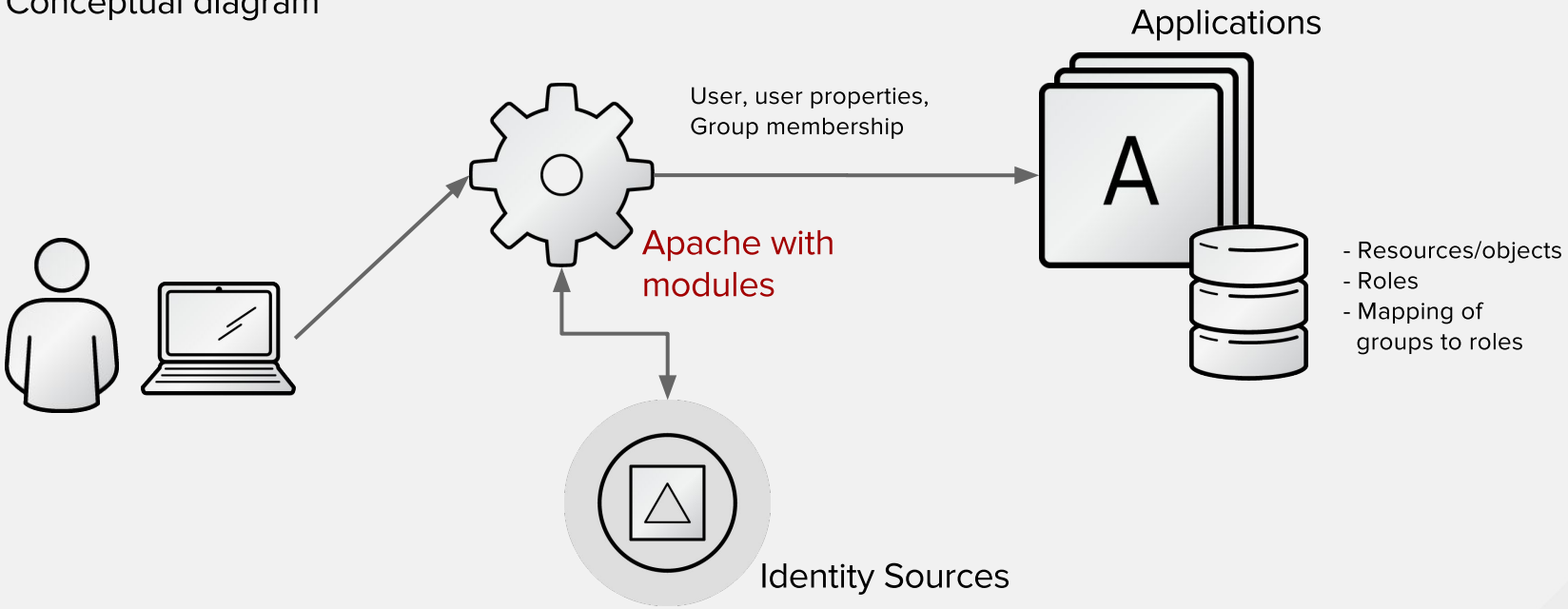
Architecture

Conceptual diagram



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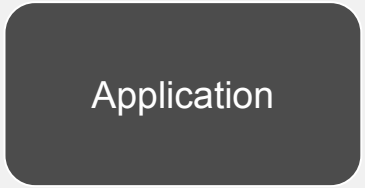
Architecture



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Architecture

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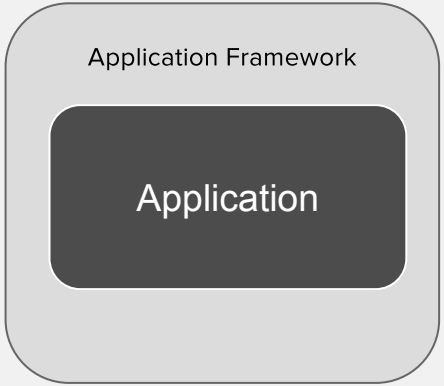
Architecture



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Architecture

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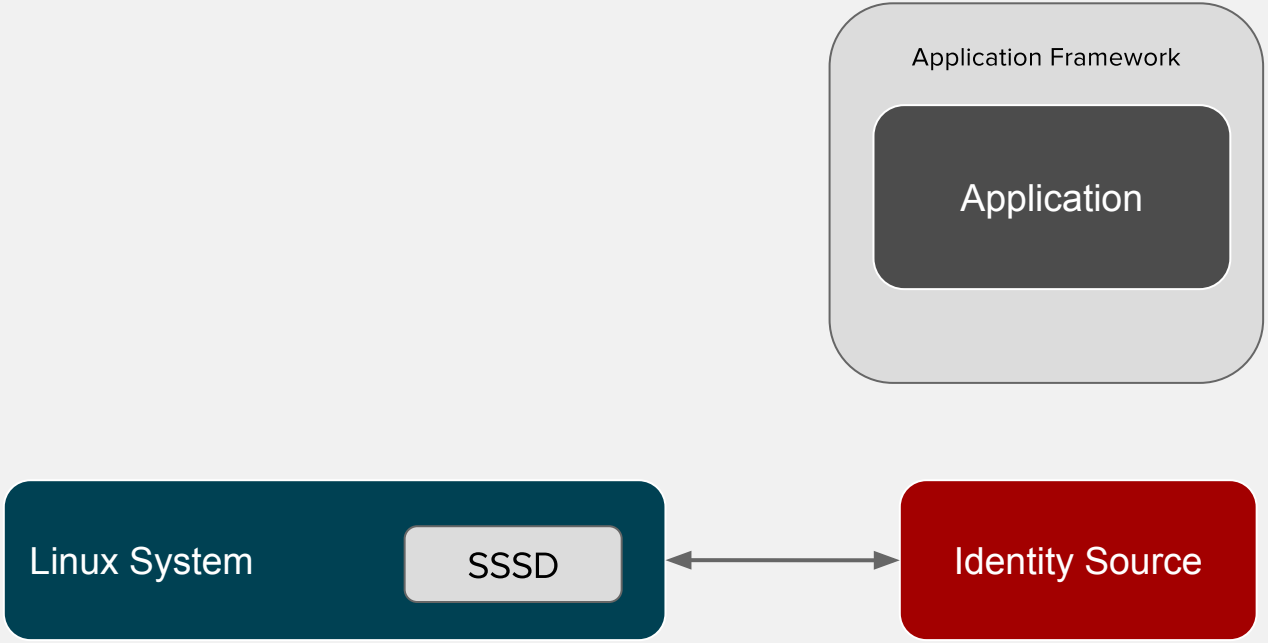
Architecture



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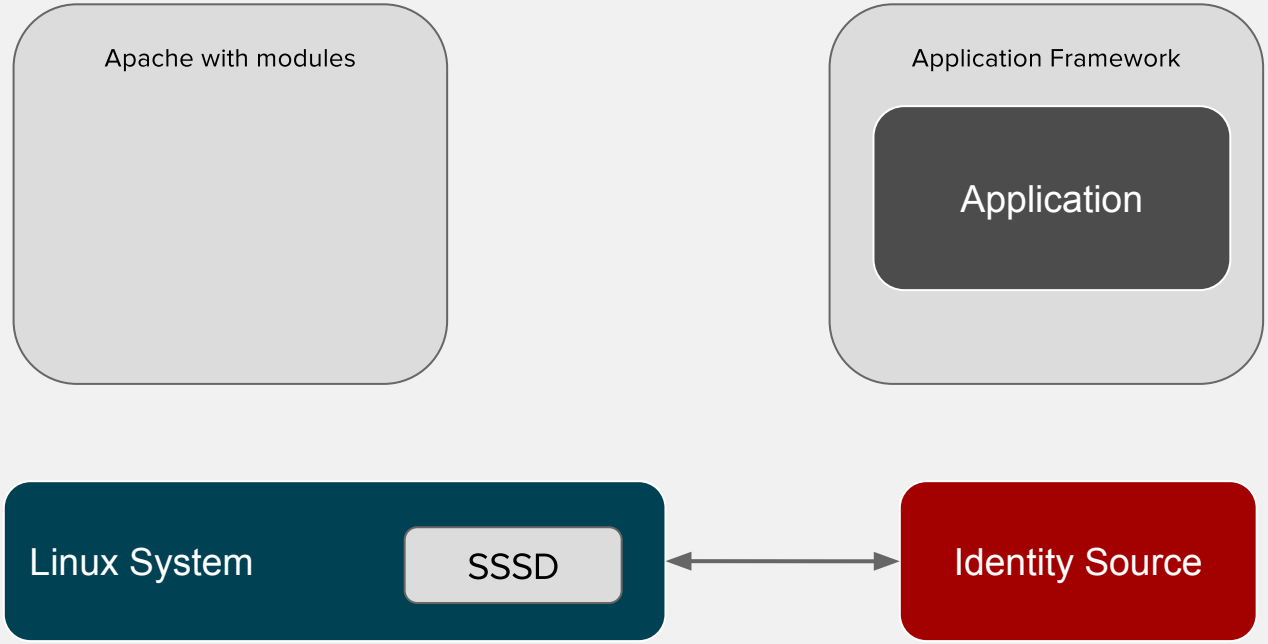
Architecture



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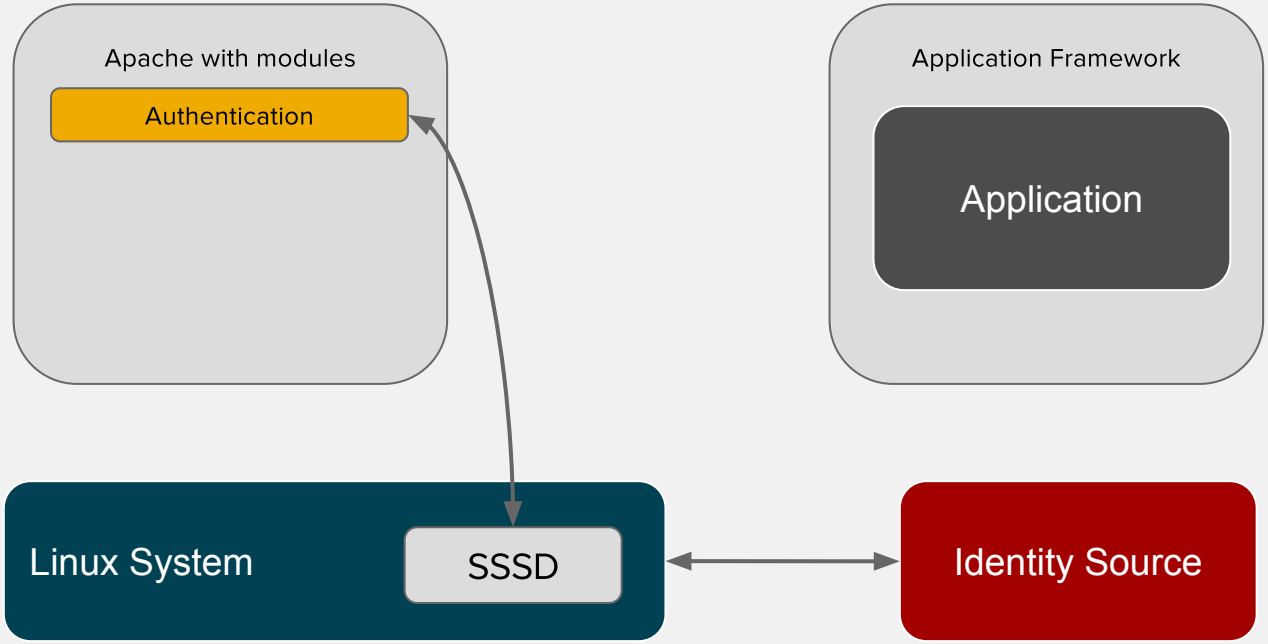
Architecture



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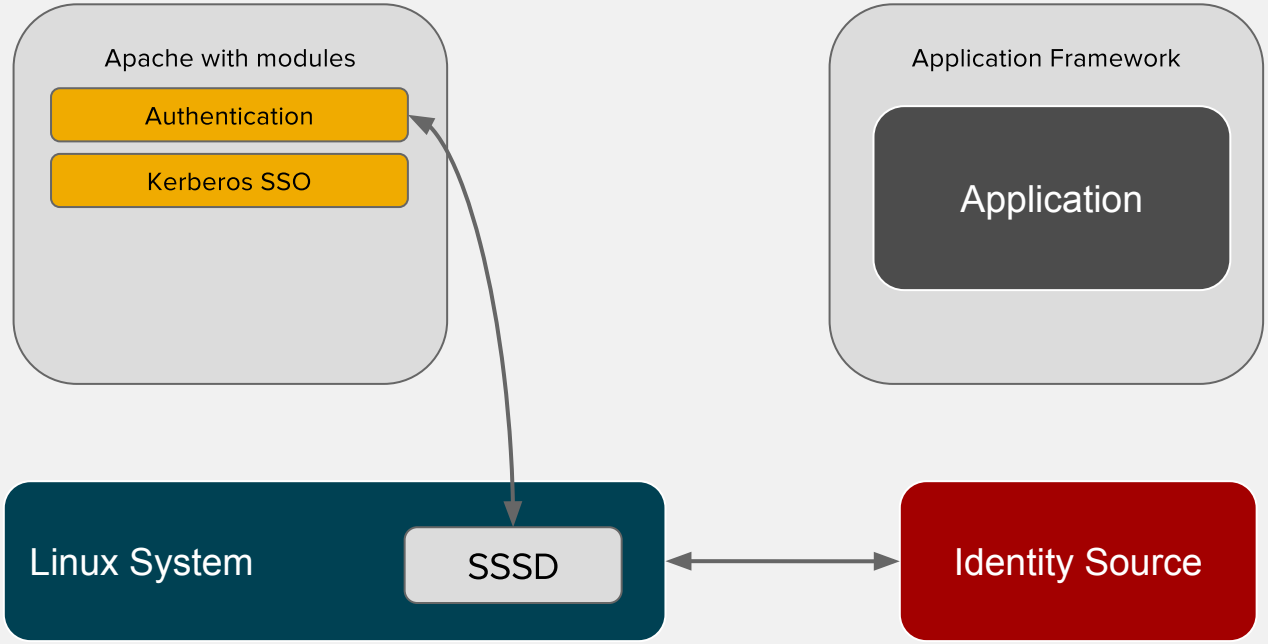
Architecture



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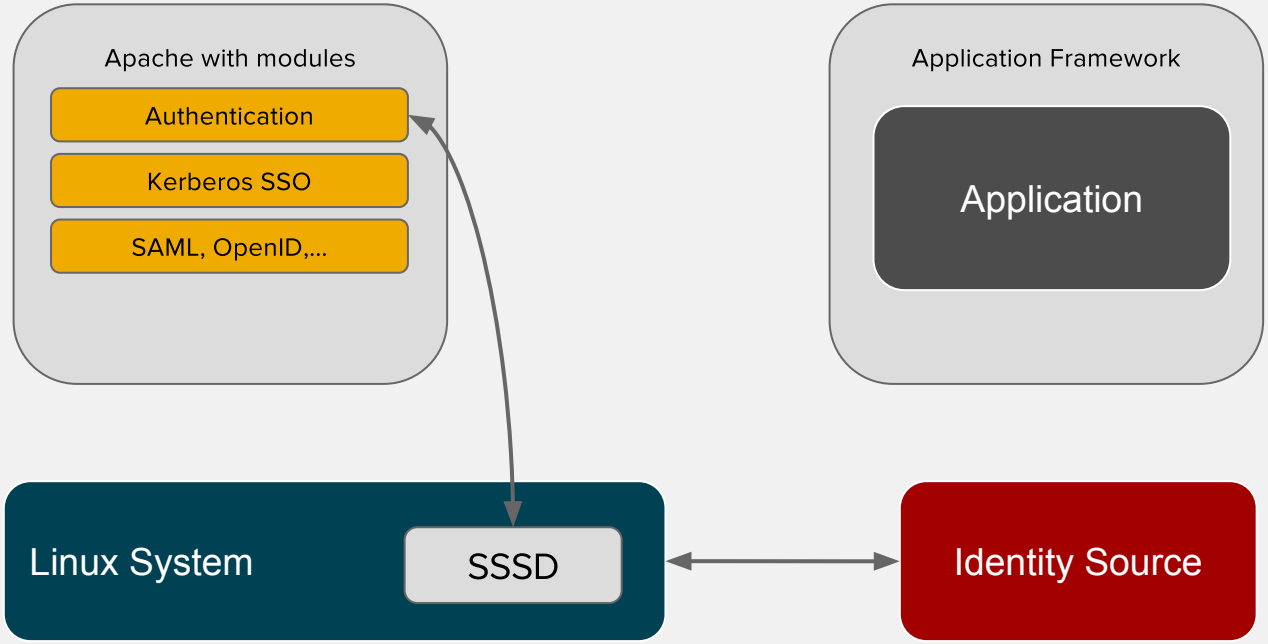
Architecture



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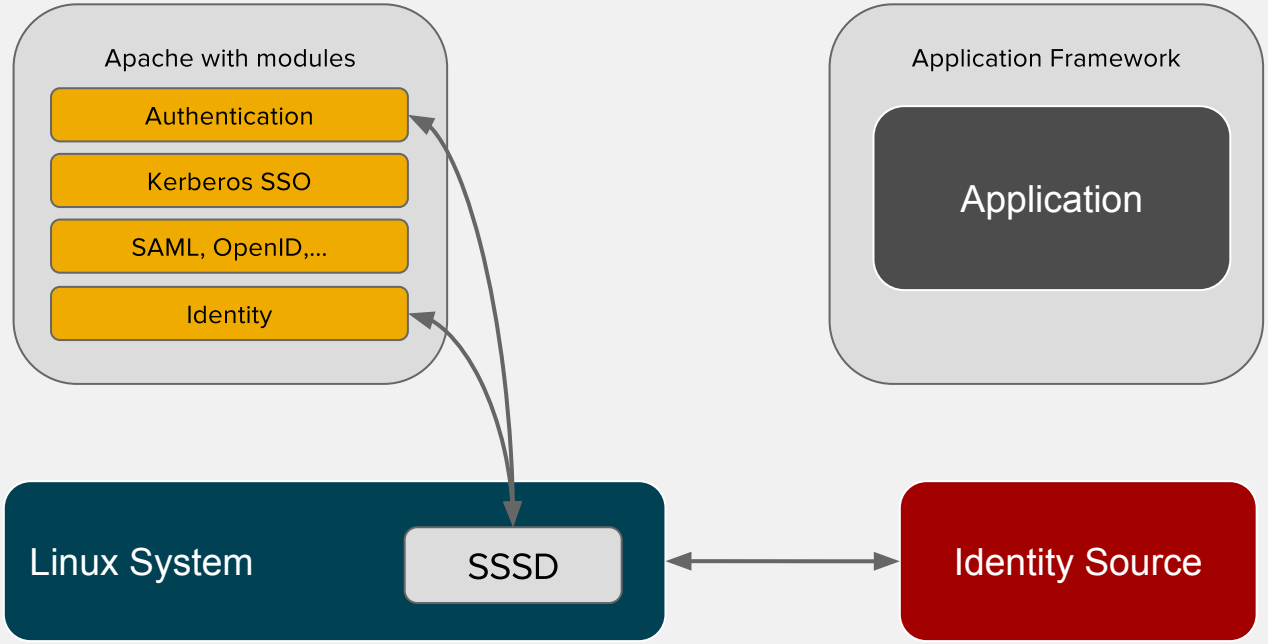

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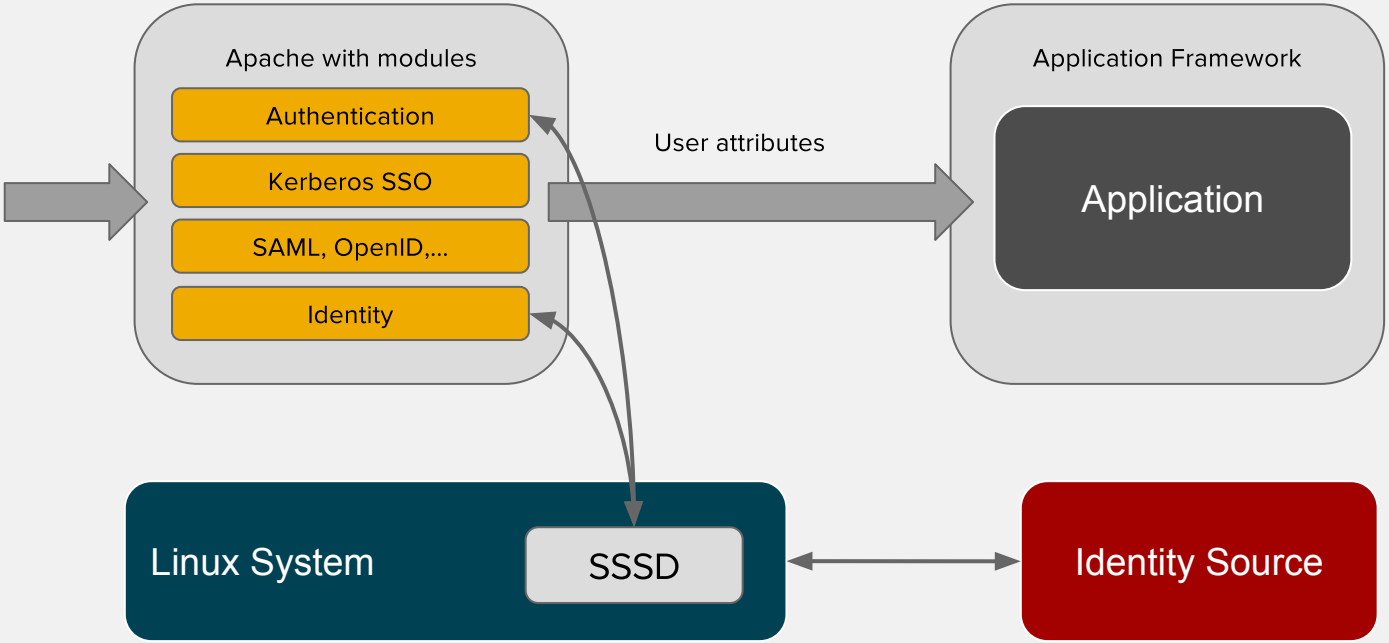

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Flow

Overview

- Request hits a URL
- Modules intercept the request
- Authenticate
- Do access control check if needed
- Fetch related information
- Pass it to the application via environment variables
- Application reads the variables and uses them

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Modules

Overview

<table>
<tr><th>Authentication Method</th><th>Authentication</th><th>Access check</th><th>Extra user info</th></tr>
<tr><td>Kerberos</td><td>mod_auth_gssapi
(mod_auth_kerb)</td><td rowspan="3">mod_authnz_pam</td><td rowspan="4">mod_lookup_idenity</td></tr>
<tr><td rowspan="2">Certificate</td><td>mod_nss</td></tr>
<tr><td>mos_ssl</td></tr>
<tr><td>Formas based</td><td colspan="2">mod_intercept_form_submit</td></tr>
<tr><td>SAML</td><td colspan="3">mod_auth_mellon</td></tr>
<tr><td>OpenID Connect</td><td colspan="3">mod_auth_openidc*</td></tr>
</table>

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Open Questions

- What about NGNIX?
  - We are working with them
- What about administrative use case?
  - SSSD has built a D-BUS interface to list users
  - Sometimes listing users is not possible so application should be ready

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Benefits

Summary

- All complexity is removed from the application
- Easy to use application in all required modes
- Enables use of the application in multiple deployment scenarios without modification
- Faster development and delivery
- Optional and flexible
- **NO MORE DIRECT LDAP CONNECTION**

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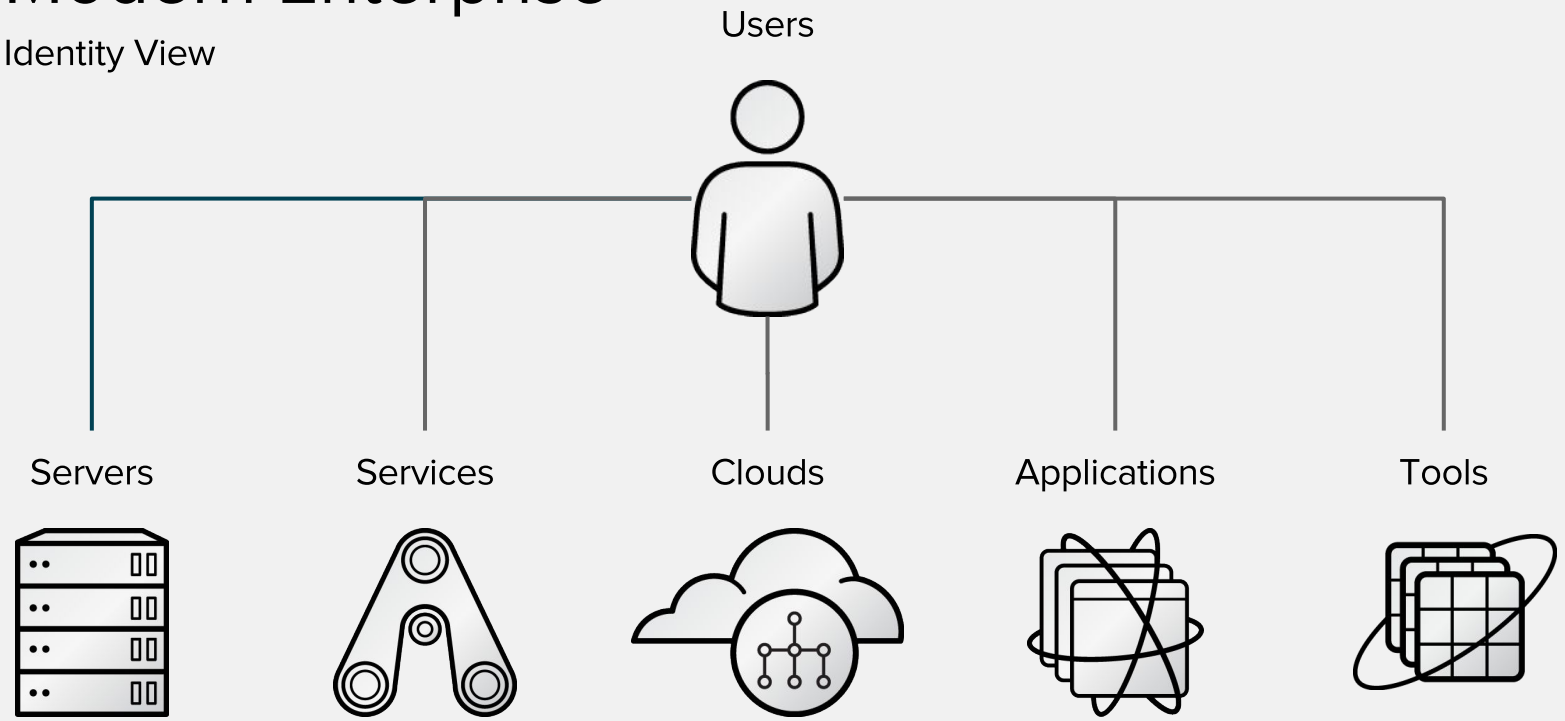
Wrap-up

Modern Enterprise

Identity View



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Resources

Summary

- FreeIPA
  - Project wiki: www.freeipa.org
  - Project trac: https://fedorahosted.org/freeipa/
  - Code: http://git.fedorahosted.org/git/?p=freeipa.git
  - Mailing lists:
    - freeipa-users@redhat.com
    - freeipa-devel@redhat.com
    - freeipa-interest@redhat.com
- SSSD: https://fedorahosted.org/sssd/
  - Mailing lists:
    - sssd-devel@lists.fedorahosted.org
    - sssd-users@lists.fedorahosted.org

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Questions?

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