Break ice or don’t login twice: FreeIPA and OAuth 2.0

Alexander Bokovoy // Francisco Triviño García

Red Hat

about:us

- FreeIPA core developers
- Engineers at Red Hat

FreeIPA

- Identity management solution:
  - provides centralized infrastructure to manage POSIX identities across a fleet of Linux machines
  - combines 389-ds LDAP server, MIT Kerberos, BIND DNS server, SSSD, Samba, and Python-based management tools
  - often seen as 'Active Directory for Linux' but this is not exactly correct comparison
  - Depends on a lot of OS components working together, can be used as a canary to detect breakage in many packages
  - Used as a core of Fedora Accounts system

FreeIPA at an operating system level

- Identity and access information
  - user and group POSIX information for Linux environments through SSSD
  - user authorization through SSSD host-based access controls
- Authentication
  - Centralized Kerberos authentication with different authentication methods
  - Single sign-on to system services
  - Centralized management of SSH public keys

FreeIPA integration to non-operating system services

FreeIPA as a backend provider

- Identity provider integration:
  - Direct identity backend to a web service with LDAP 'driver'
  - SSSD as an identity backend to a web service
    - Ipsilon and Keycloak
    - Apache module `mod_lookup_identity`
    - NGINX module `nginx_http_lookup_identity_module`
- Authentication integration:
  - LDAP BIND
  - SPNEGO/Kerberos
    - Apache module `mod_auth_gssapi`
  - PAM authentication via SSSD PAM module
    - Apache module `mod_authnz_pam`
    - NGINX module `nginx_http_authnz_pam_module`

Disadvantages

- Applications authors haven't really mastered LDAP and Kerberos
  - some frameworks do allow for extensibility but documentation isn't great
- Typical integration approaches struggle to scale
  - a single LDAP server in a configuration
  - lack of support for more than 'username+password' methods
  - Java-based frameworks have outdated Kerberos support, aren't aware about features added since 2010
  - Java-based frameworks struggle to integrate with UNIX domain sockets
  - Micro-services often cannot be assumed to use system-wide domain enrollment details
- Web services moved on to OAuth 2.0 authorization framework
  - OAuth 2.0 methods rely on browser redirects

OAuth 2.0 authorization framework

- Web services moved on to OAuth 2.0 authorization framework
  - Identity Provider (IdP) handles authentication and authorization, one place to focus on instead of every single app
  - Applications rely on IdP-issued grant to operate
- Web services map OAuth 2.0 subjects, not system-level ‘users’, it gives a bit of flexibility to map ‘POSIX’ users

FreeIPA as a consumer of external resources

Consume external identities

- Trust to Active Directory

Consume external authentication

- FreeIPA already allows to authenticate against an external source with RADIUS protocol
  - exposed through a Kerberos pre-authentication method
  - user details stored in FreeIPA, authentication handled by external source
- RADIUS support has some limitations:
  - single RADIUS server end-point per each user
  - only supports 'PIN + token' opaque scheme
  - cannot support conversation protocols

OAuth 2.0 authorization and access to system-level resources

OAuth 2.0 moves authentication step to IdP

- Authentication is not visible to OAuth 2.0 clients, they ask IdP for a grant to access resources instead
  - IdP authenticates the user, if needed, and asks the user to authorize the request
  - All this implies use of a browser and HTTP-based redirects
  - Hard to integrate without browsers being available
  - OAuth 2.0 has few authorization flows to address different use cases; they all still need the browser to be present somewhere

We want to use OAuth 2.0 framework flows to log in over SSH

- How can we avoid running a browser on the server side?

Wait, this is a familiar issue, right?

Captive portals at public Wi-Fi access points

- how to login as a network-bound user if a Wi-Fi access point wants to show a browser window to ‘click the checkbox’ before the login?

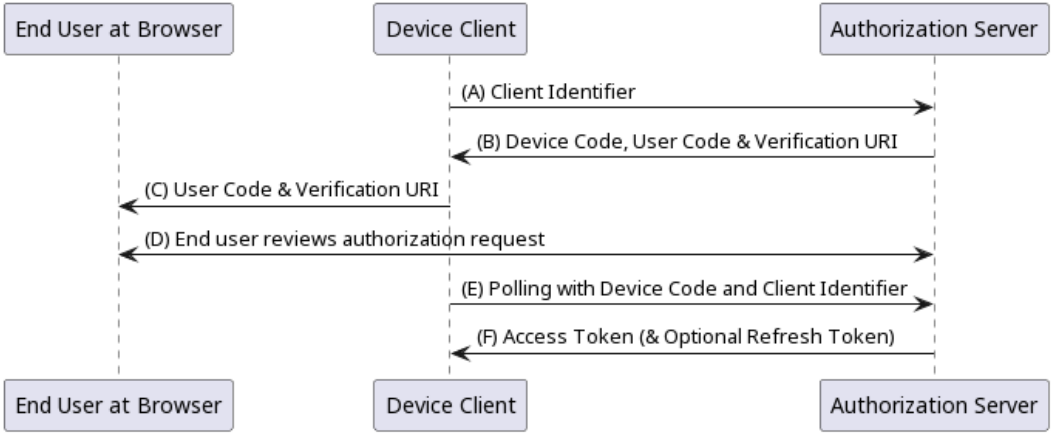
Passwordless authentication

- how can we help to improve Linux login experience?

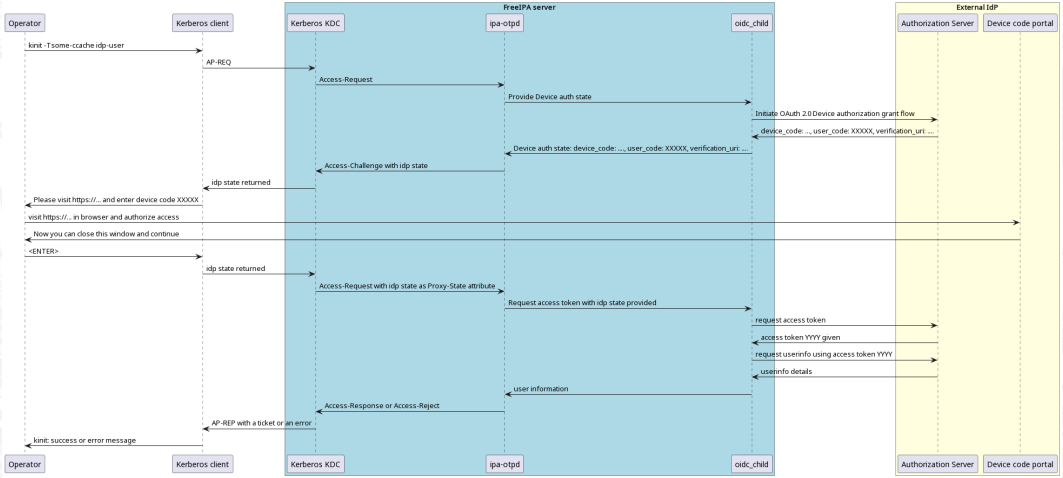
How to run untrusted code prior to login?

Demo 1: log in over SSH

Using OAuth 2.0 device authorization grant flow



Actual flow for FreeIPA



Actual flow for FreeIPA

Detailed guides

- FreeIPA workshop: chapter 12: Authentication against external Identity Providers
- FreeIPA design documents: general design and IPA API design for IdP

Actual flow for FreeIPA

FreeIPA client code is scoped in the MIT Kerberos pre-authentication module

- provided by SSSD project as `sssd-idp` subpackage
- tells KDC "I support OAuth 2.0 method, consider it"
- shows KDC response as "Authenticate at https://... and press ENTER."

FreeIPA server side is reusing RADIUS helper **`ipa-otpd`**

- KDC side of the MIT Kerberos pre-authentication module triggers IdP support
- KDC asks RADIUS helper `ipa-otpd` to handle it
- `ipa-otpd` calls SSSD-provided `oidc_child` helper to talk OAuth 2.0 to user-specific IdP
- on successful authorization response from IdP, KDC issues a Kerberos ticket

User runs browser elsewhere

Kerberos ticket is issued for the user

Possible integration

Authentication is done by an external IdP

Authorization grant is turned into a Kerberos ticket by FreeIPA KDC

- Kerberos authentication indicator "`idp`" is assigned to the ticket

Kerberos ticket is consumed by an IPA-enrolled application

- application can check the authentication indicator and deny non-IdP access
  - `pam_sss_gss` PAM module can be used to limit `sudo` access
  - `mod_auth_gssapi` Apache module can be used to limit authentication to web sites

OAuth 2.0 device authorization grant flow

Tested against multiple public IdPs

- Keycloak / Red Hat Single Sign-On
- Google
- Github
- Microsoft Azure
- Okta

Does not work against IdPs which do not implement OAuth 2.0 device authorization grant

- Ipsilon (Fedora Accounts)
- Gitlab

Demo 2: Keycloak and Nextcloud

A generic backend dream

System for cross-domain identity management (SCIM v2.0)

- RFCs 7642 / 7643 / 7644
- Automation of the user identity information exchange between identity domains
- Supported by many proprietary identity providers
- Exposes user and group information and access methods over REST API (over HTTPS)

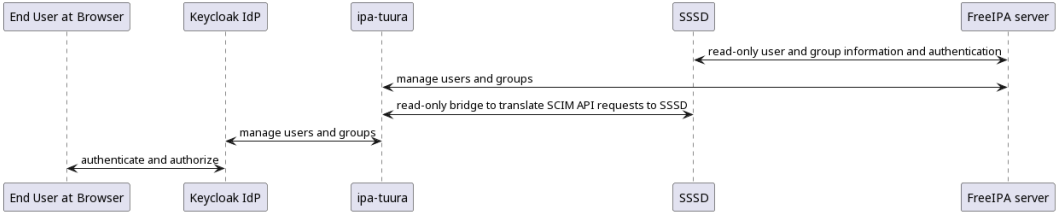
SCIMv2 PoC

ipa-tuura - a proof of concept SCIMv2 bridge between FreeIPA and IdPs

- tuura – Finnish word for an ice chisel, a tool for breaking ice

Current scope

- Supports FreeIPA, LDAP, and Active Directory as read sources
- Supports FreeIPA, LDAP, and Active Directory as writable targets
- Rudimentary password authentication support



SCIMv2 PoC

PoC code:

- Django application combining IPA API and a SCIMv2 Python module: freeipa/ipa-tuura
- Keycloak user store plugin to connect over SCIMv2: justin-stephenson/scim-keycloak-user-storage-spi

Future plans

A transparent bridge between FreeIPA and OAuth 2.0 IdPs

IPA-enrolled applications to benefit from OAuth 2.0 client support

- e.g. Cockpit UI on each server to accept OAuth 2.0 authentication of IPA users
- FreeIPA Web UI integration

Secure transition from OAuth 2.0 grant to Kerberos on behalf of a user

WebAuthn / FIDO2 support

OAuth 2.0 IdPs already have support for WebAuth tokens

- FreeIPA 4.9.10+ can authenticate users with WebAuthn tokens through external IdP integration

SSSD plans to support FIDO2 tokens natively

- Locally, with `libfido2` first, to replace `pam_u2f`
- Over Kerberos for integration with FreeIPA

Integrate with GNOME login

Enable passwordless FreeIPA deployments

SCIMv2 support

Turn PoC project freeipa/ipa-tuura into a production code

- Automate integration with known SCIMv2 providers
- Support more IdPs
- Add more authentication methods
- ...

Thanks!