Group-Based File Access Control System

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Introduction

This project aims to implement Role-Based Access Control (RBAC) in a Linux environment. By improving traditional file access control mechanisms, we propose a system that enables fine-grained permission management based on predefined rules. Using the **LD_PRELOAD** technique, we hook essential file and process access functions (such as **open** and **execve**) to enforce role-based permissions. The solution consists of two components: an **administrator program** and a **hooking shared library** (SO file).

Implementation Plan

Administrator Program

The administrator program, developed in Python, provides the following core functionalities:

- Creation and deletion of rules.
- Adding or removing members from rules.
- Displaying member lists for each rule.
- Generating and updating mapping files based on file paths and rule-based permissions.

Mapping information is managed in CSV format for user-rule associations and maintained as separate files for file-rule permissions. This ensures easy integration and updates.

Hooking Shared Library

The shared library, written in C, hooks into existing system calls via the **LD_PRELOAD** environment variable. The key operations are:

- Reading user-rule mapping files and file-rule permission files.
- Checking the rule and associated permissions of the user attempting access.
- Allowing the original function call if permissions are valid or returning an appropriate error code otherwise.

Conclusion

This project provides a robust RBAC solution for Linux file systems by introducing rule-based access control. By combining **LD_PRELOAD** hooking with a Python-based administrator program, the solution offers flexible and precise permission management. It complements the traditional Discretionary Access Control (DAC) mechanism in Linux with a role-oriented approach, enabling secure and efficient file access control. Ultimately, this solution demonstrates strong applicability in enterprise environments requiring advanced permission management.