Title:

BPF-based Optimization for FUSE-based Remote File Systems

Supervisor:

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Modern operating systems rely on file systems to efficiently manage and organize stored data. Traditional file systems are implemented in the OS kernel and provide direct access to storage devices, while User-space file systems are built on top of traditional file systems and are implemented in user space using User-Space File System Libraries like FUSE library to communicate with the kernel's VFS.

Virtual File System (VFS) is a key component in Linux that provides a standard interface for accessing storage devices. It abstracts the details of file system implementation, enabling applications to interact with files, directories, and other resources in a uniform way, regardless of the underlying file system. Traditional file systems allow applications to interact with VFS using a direct interface, such as POSIX. User-space file systems, however, use libraries like libfuse to access the VFS in a way that conforms to the POSIX standard.

In addition, VFS enhances performance by caching frequently accessed file data in the page cache, which is a memory buffer utilized by the operating system to store recently accessed file data. However, when a user-space file system accesses remote data from a server, the data must be cached to the VFS page cache for performance. This requires copying the data through the network stack (in the kernel) to libfuse (in userspace), then transferring it back to VFS (in the kernel) to be placed in the Page Cache.

To improve this process, this internship aims to investigate methods for caching data directly into the Page cache from the network stack when accessing remote server file data, utilizing Berkeley Packet Filter (BPF) framework. By doing so, we aim to optimize the caching process, improving latency and overall system performance.

The main phases of the internship are:
- Understand FUSE
- Understand BPF
- Understand Linux's page cache and VFS
- Deploy a FUSE-based remote file system (we have several prototypes)
- Design and implement our idea
- Evaluate our solution
- Write a report

Required skills
- C programing
- Motivation
- Sociable
- Understand quickly
- Love Systems
- Linux
- Kernel programing is not mandatory, you will learn with us