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ALL FILE SYSTEMS ARE NOT CREATED EQUAL: ON THE COMPLEXITY OF CRAFTING CRASH-CONSISTENT APPLICATIONS

This paper provides a comprehensive study of the crash-consistency protocols of applications implemented on top of modern file systems. It is observed that applications use complex update protocols to persist states, and the correctness of those protocols is highly dependent on the file system. A problem of how to guarantee the crash-consistency of applications when they are dependent of the file system is raised.

To answer those problem, first, the authors introduce the term *persistence properties* and develop a tool named BOB to test those properties and explore possible on-disk crash states that may arise. Secondly, a framework named ALICE is developed to analyze application update protocols and find crash vulnerabilities. This is achieved by finding permutations of the system-call trace of workloads in order to understand the underlying logic of applications.

This paper identifies a problem within the modern operating systems that is the application-level crash-consistency protocols are dependent on the underlying file system. This problem results in vulnerabilities that can cause corruption or data loss. The developed tool and framework of the authors could be used in future researches and becomes a part of the file-system design process.

A limitation is that the ALICE framework does not support workloads that are concurrent and relies on synchronization mechanism of applications. Moreover, the experiments conducted are only on the representatives of the Linux file-system. A study on commercial file systems such as NTFS, HFS, … would provide a more comprehensive look.