Unleashing the Power of Unikernels with Unikraft

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ABSTRACT

Recent research has shown that unikernels, lightweight virtual machines tailored to specific applications, have great potential in terms of performance, tiny boot times, small memory consumption, and a reduced trusted compute base. Creating and optimizing them, however, is currently a painful, time-consuming process that often needs redoing for every application. With Unikraft, we introduce a system for automatically building unikernels that drastically reduces this time without negatively impacting performance.

CCS CONCEPTS

• **Software and its engineering → Operating systems**;

KEYWORDS

Unikernels, Specialization, Operating systems, Virtual machines

1 PROBLEM

When selecting a platform, application developers and service providers have to make difficult choices between performance, isolation, and development time to port applications to new OSes. Typical compromises are (1) virtual machines running general-purpose OSes, which provide great isolation, require no porting time but bad performance; (2) containers, which yield great performance, require no or very little porting time but come with a number of isolation issues as a result of supporting large system APIs; or (3) unikernels, which provide superb performance, great isolation and a small trusted compute base, but are terrible in terms of development time since applications have to be ported to a non-standard, minimalistic OS [1].

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2 DESIGN AND EARLY RESULTS

Unikraft aims to remove this difficult choice from the equation, allowing for efficient, high performance images, small development/porting time, excellent isolation and a potentially small trusted compute base, all the while supporting multiple platforms (e.g., bare metal, KVM, Xen, etc.) without requiring additional work from the application developer.

Unikraft, an open source project under the auspices of the Linux Foundation [2], is a novel library-based operating system targeting the automated construction of extremely efficient unikernels. As opposed to related work [3], Unikraft is agnostic to the underlying hardware or virtualization technology; for instance, it is able to build images that can run on KVM, Xen, Firecracker, Solo5, or as OCI container.

To showcase its potential, we present early results in terms of memory sizes and boot up times of Unikraft images on different virtualization technologies. As future work, we are investigating in simplifying and automating porting of applications. We are developing tools to automatically detect and optimize Unikraft (micro-)libraries that are needed by an application; finally, we will investigate the use of machine learning techniques to create a cycle of image creation, measurement, and image re-configuration in order to automatically tune the performance of Unikraft images according to given KPIs.

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