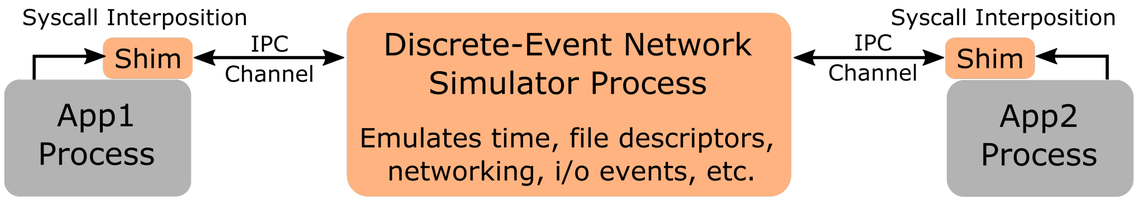
Expanding Research Frontiers with a Next-Generation Anonymous Communication Experimentation (ACE) Framework

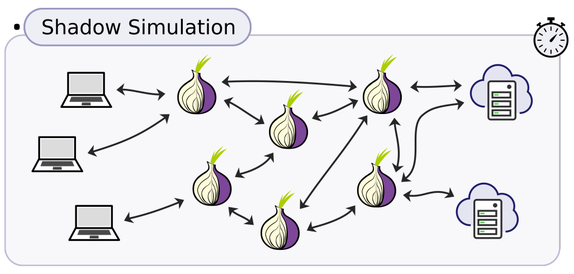
Rob Jansen, U.S. Naval Research Laboratory
Micah Sherr, Georgetown University (prime org.)
Roger Dingledine, Tor Project, Inc.
https://shadow.github.io/

ACE enhancements have been integrated into Shadow, a discrete-event network simulator that directly executes real unmodified application code.



Processes are co-opted by Shadow to emulate Linux system calls and simulate network characteristics.

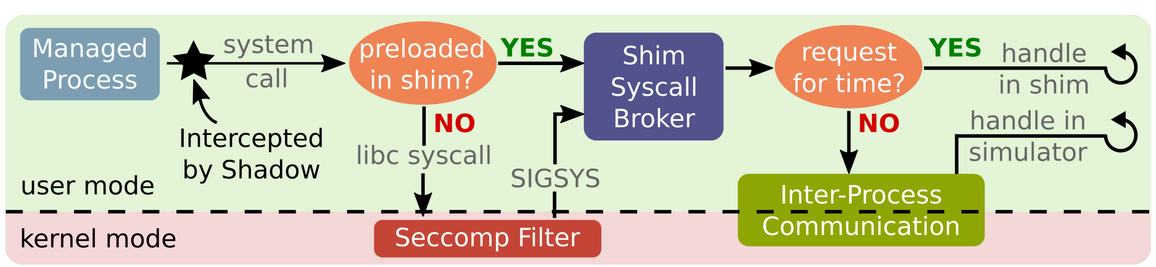
Simulate distributed systems with thousands of network-connected processes in realistic and scalable private network experiments.



Shadow is designed to be application-independent, but excels at simulating Tor.

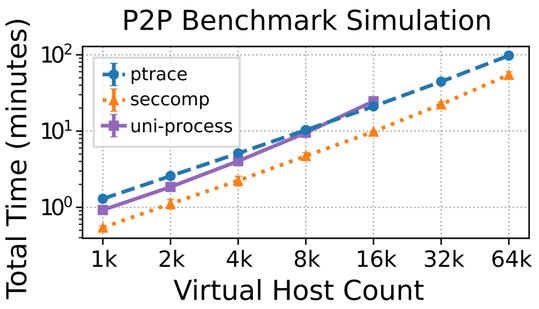
Time, network traffic, thread synchronization, and more are deterministically controlled.

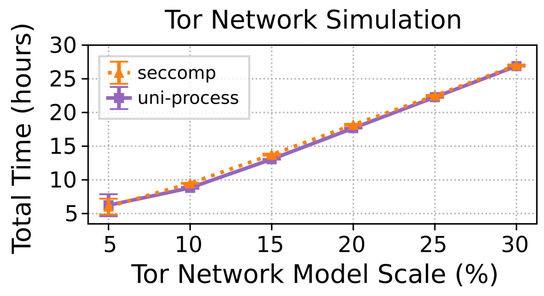
Shadow has been re-architectured to support more applications, using a multi-process design and OS-level interposition.



Low interposition overhead due to the combination of system call interposition using seccomp, function call interposition using LD_PRELOAD, and a shared-memory based inter-process communication channel.

Improving application compatibility without reducing performance.





Shadow's seccomp-based multi-process architecture has similar or better performance than its old state-of-the-art uni-process architecture, while also being able to support more applications.

Development to support more applications is ongoing.

Shadow/ACE is improving daily, with recent features such as:

- improved support for signal handling
- improved logging and debugging for managed applications
- additional and improved syscall implementations
- preliminary support for applications which use Go, Java, and Python

Try Shadow for your network simulations!

Run on your Linux laptop, desktop, or server. With a quick installation and simple examples, get started in only a few minutes.

https://github.com/shadow/shadow

Shadow is compatible with Tor, and has preliminary support for NGINX, Go, Python, Java, cURL, iPerf, and more.

Broader impacts:

ACE improves the ability to communicate privately and securely online. Ordinary Internet users as well as activists, whistleblowers, law enforcement officials, members of the military and other government officials, and businesses are among those who use anonymity networks to protect their privacy online. The research activities produce and enhance tools that can be used to significantly strengthen anonymity systems by improving the ability to experiment with and understand the effects of their design.

ACE improves the ability to conduct research on anonymous communication systems, which in turn will enhance the ability of Internet users to more privately and freely access and contribute information.

More generally, ACE helps researchers develop protocols and tools that allow people to communicate more privately and securely.