bpfbox: Simple Precise Process Confinement in eBPF

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Outline of Talk

What is eBPF?

Motivation

bpfbox Architecture

bpfbox Policy

Performance Evaluation

Conclusion

What is eBPF?

eBPF in the Beginning

eBPF ≡ **E**xtended **B**erkley **P**acket **F**ilter...

- But it has little to do with Berkley, packets, or filtering nowadays

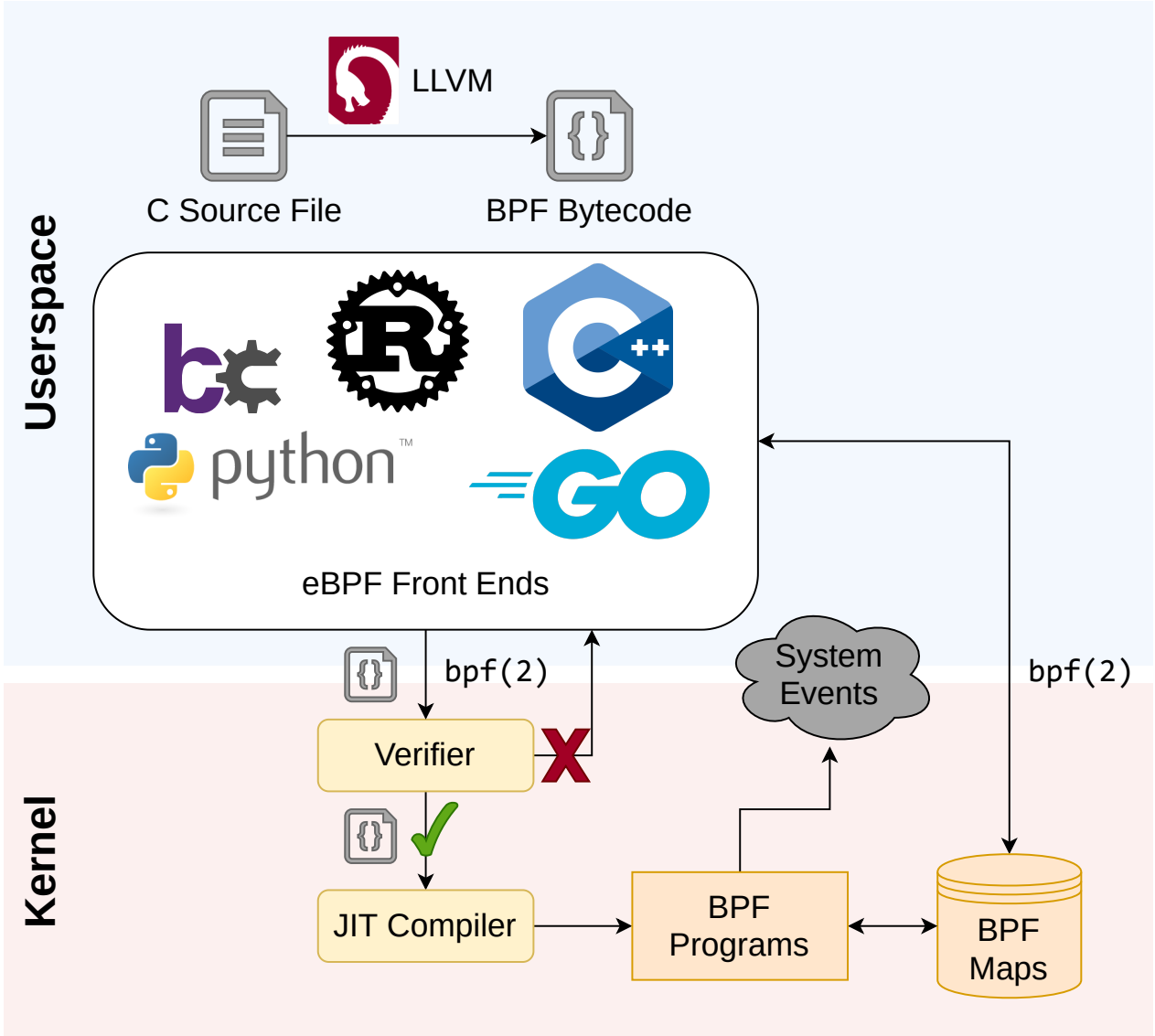
So then **what is eBPF?**

- A major re-write of the Linux BPF engine
  - Alexei Starovoitov and Daniel Borkman
- Merged into the Linux kernel in 2014
- The point was fine-grained, cross-layer **system introspection**

What Can eBPF Do?

Direct Packet Access	Userspace Functions	Hardware	LSM Hooks
TCP / IP	System Calls	Block Device I/O	And much more...
Sockets	Kernelspace Functions	Stack Traces	

How eBPF Works



eBPF in 2020

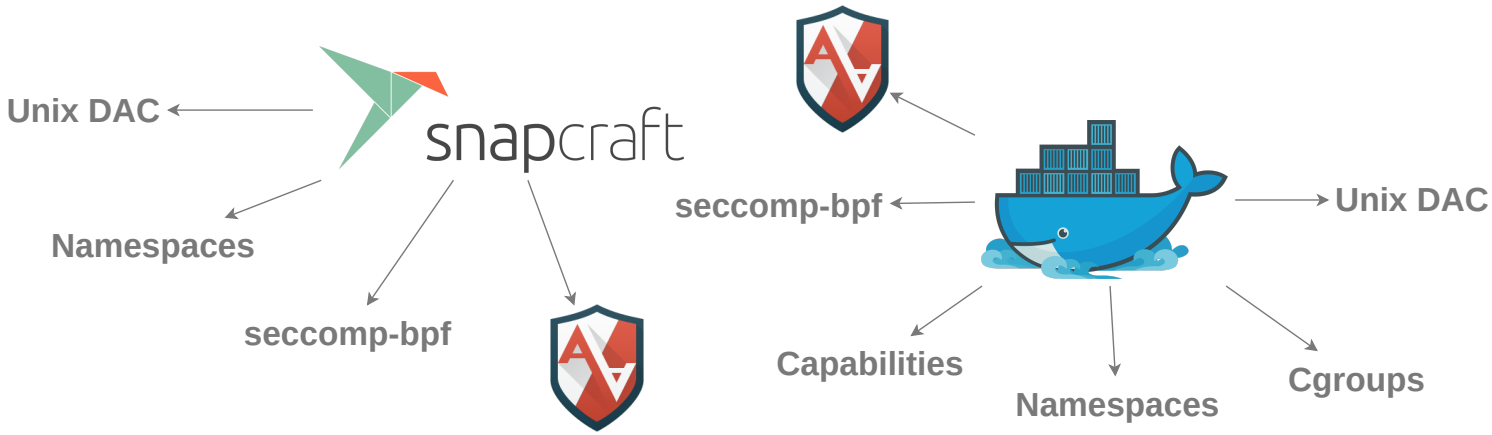
eBPF is now **more than just an observability tool**.

- TODO

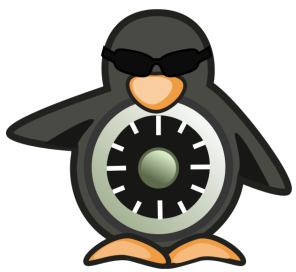
Motivation

The Status Quo

- Existing process confinement mechanisms are **complex**



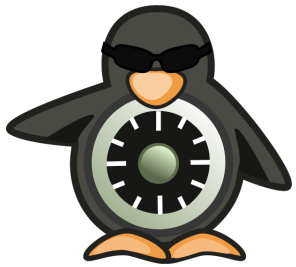
- Existing process confinement mechanisms are **difficult to use**



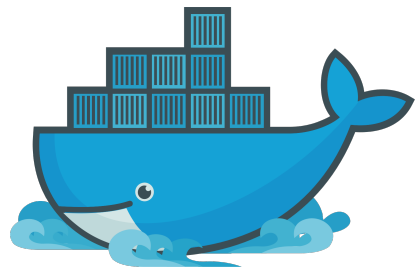
- Can we do any better?

Stakeholders as Policy Authors

- **Security experts** define the policy



- **Application authors** and **packagers** define the policy



- **End users** define the policy

???

eBPF Changes the Game

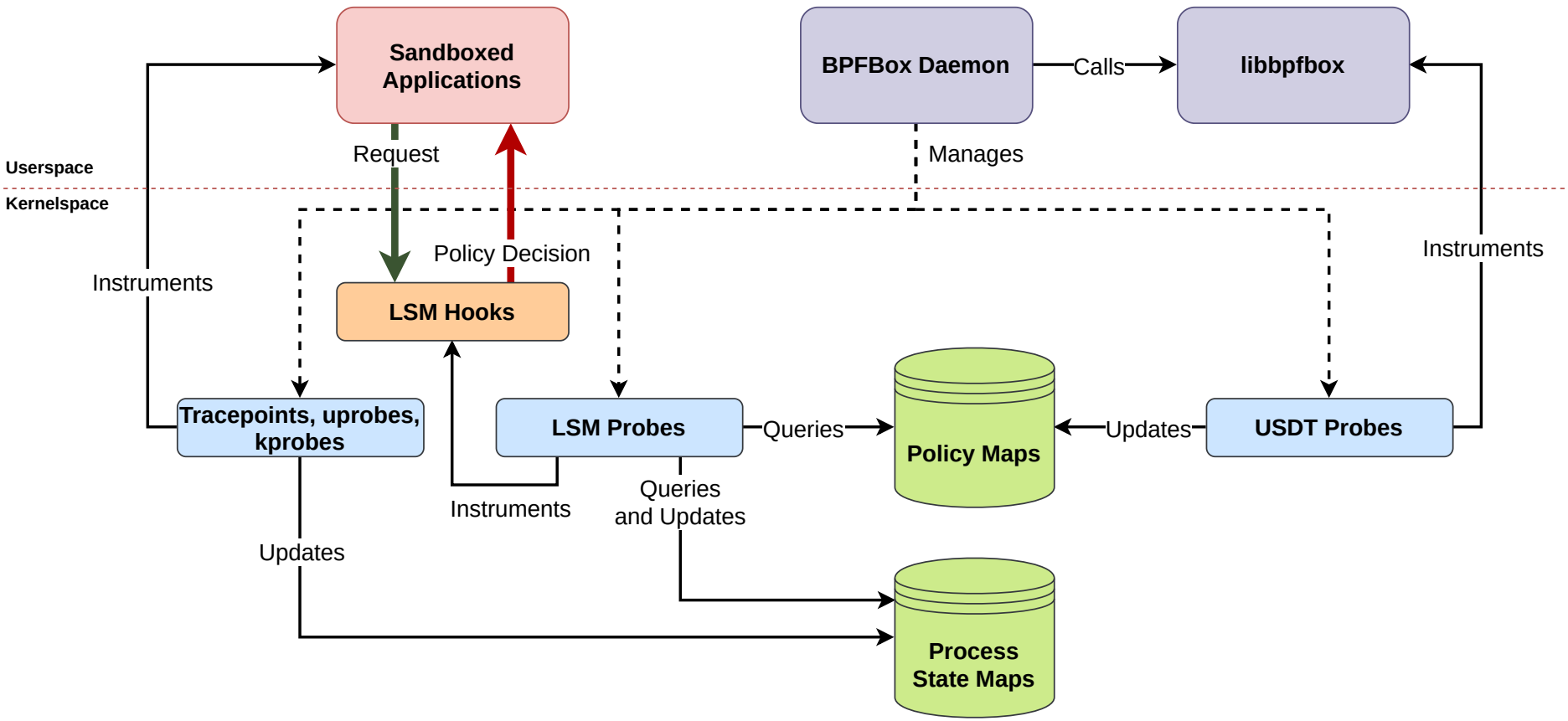
TODO

bpfbox Architecture

bpfbox Architecture

- TODO: Python3 bcc
- TODO: KRSI
- TODO: Lines of userspace code
- TODO: Lines of kernelspace code
- TODO: Compare w/ SELinux, AppArmor

bpfbox Architecture



bpfbox Policy

Policy at the Function Call Level

```
#![profile /sbin/mylogin]

#[func check_password]
#[func add_user]
#[allow] {
    read("/etc/passwd")
    read("/etc/shadow")
}

#[func add_user]
#[allow] {
    append("/etc/passwd")
    append("/etc/shadow")
}
```

Performance Evaluation

Performance

TODO

Conclusion

Acknowledgements

Special thanks to:

- **Alexei Starovoitov** and **Daniel Borkman** (creators of eBPF)
- **K.P. Singh** (creator of KRSI)
- Fellow **bcc contributors** (an awesome eBPF framework)
- Anonymous **CCSW'2020 reviewers** (valuable feedback)

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Contributions

- First full policy **enforcement engine** written in eBPF
- Integration of **userspace** and **kernelspace** state with **LSM layer enforcement**
- A simple policy language for **ad hoc process confinement**
  - But with optional complexity for **fine-grained protection**

Check out the project on GitHub!