

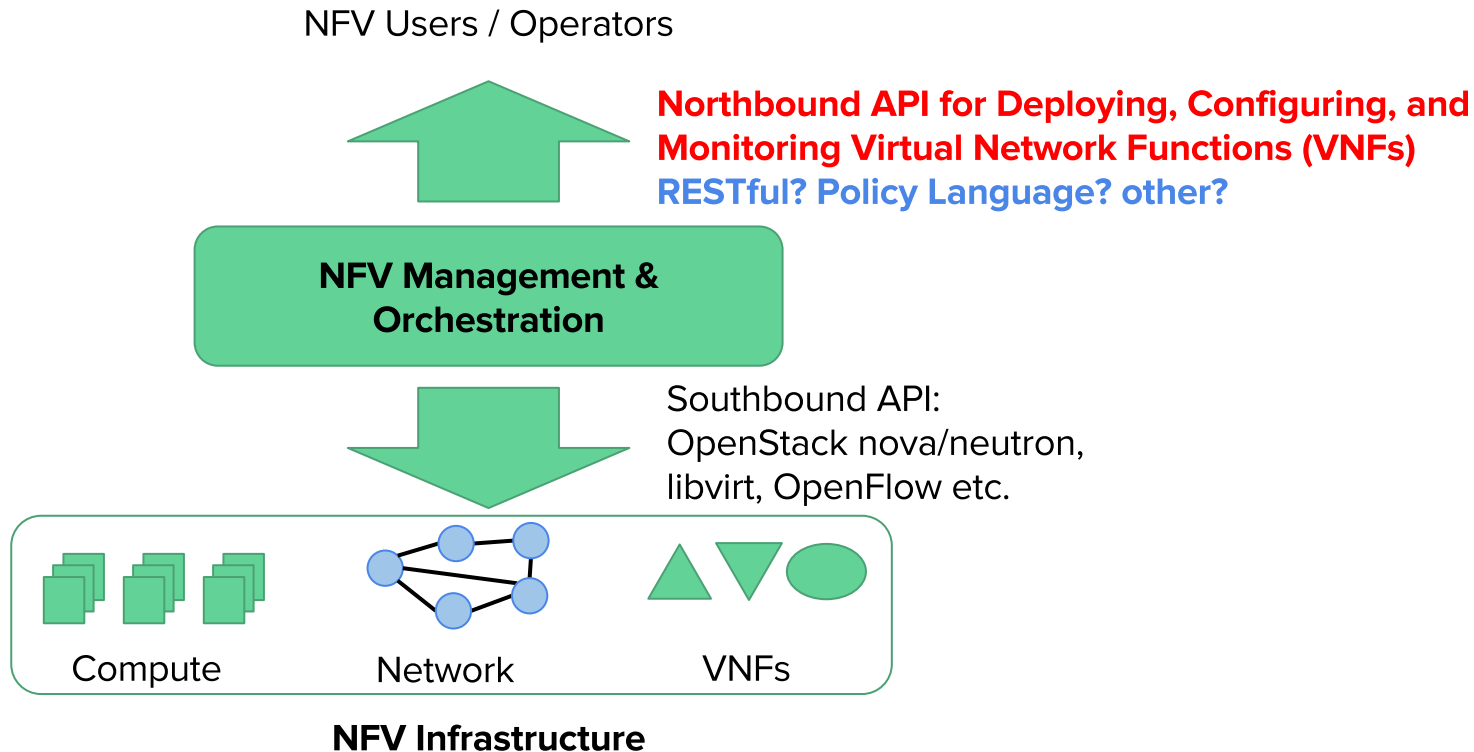
nf.io: A File System Abstraction for NFV Orchestration

Md. Faizul Bari, **Shihabur R. Chowdhury**, Reaz Ahmed, and Raouf Boutaba
David R. Cheriton School of Computer Science
University of Waterloo

Outline

- What is nf.io?
- Related works
- Why File System abstraction?
- The nf.io File System Abstraction
- Sample Use cases
- System Architecture
- Prototype Implementation
- Work in Progress
- Conclusion

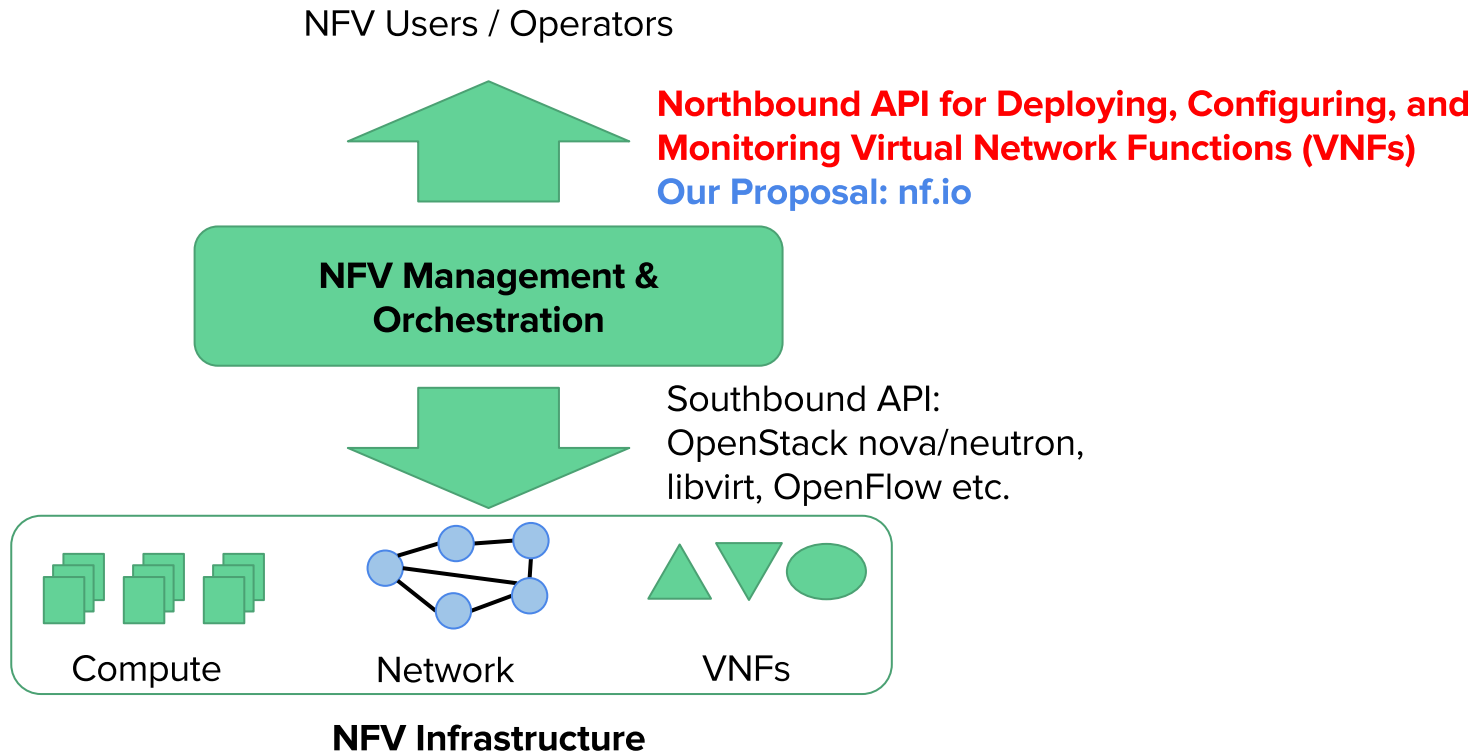
What is nf.io?



Northbound API for Deploying, Configuring, and Monitoring Virtual Network Functions (VNFs)
RESTful? Policy Language? other?

Southbound API:
OpenStack nova/neutron,
libvirt, OpenFlow etc.

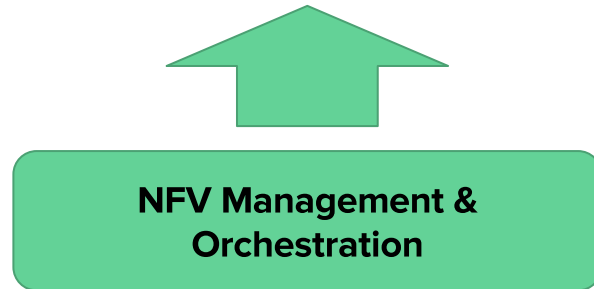
What is nf.io?



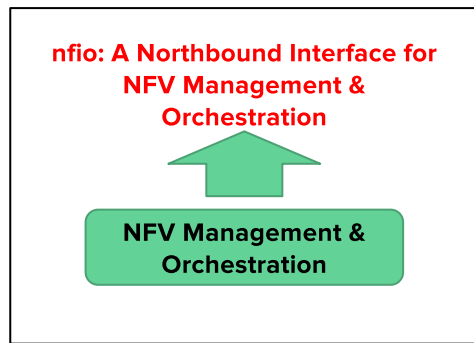
* Simplified view of ETSI Reference NFV Architecture

What is nf.io?

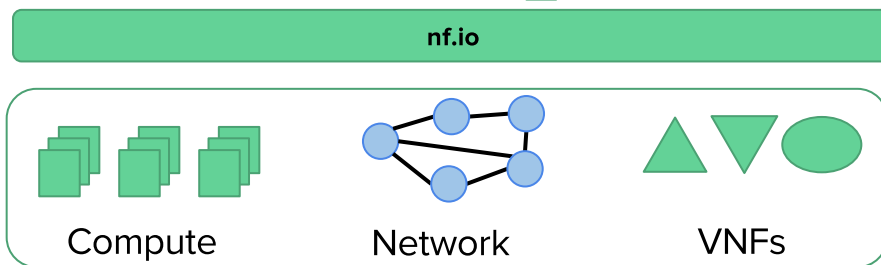
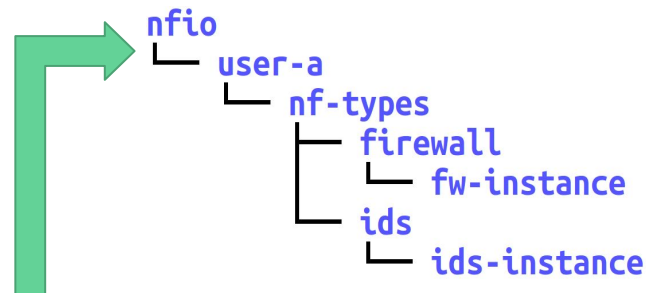
**nf.io: A Northbound Interface for NFV
Management & Orchestration**



What is nf.io?

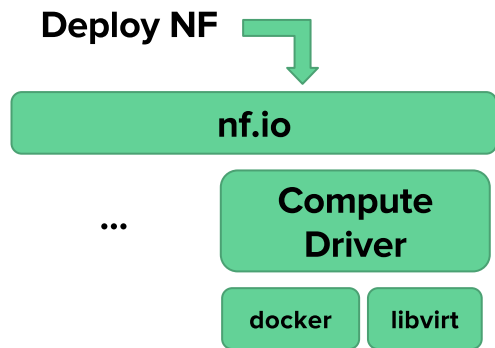
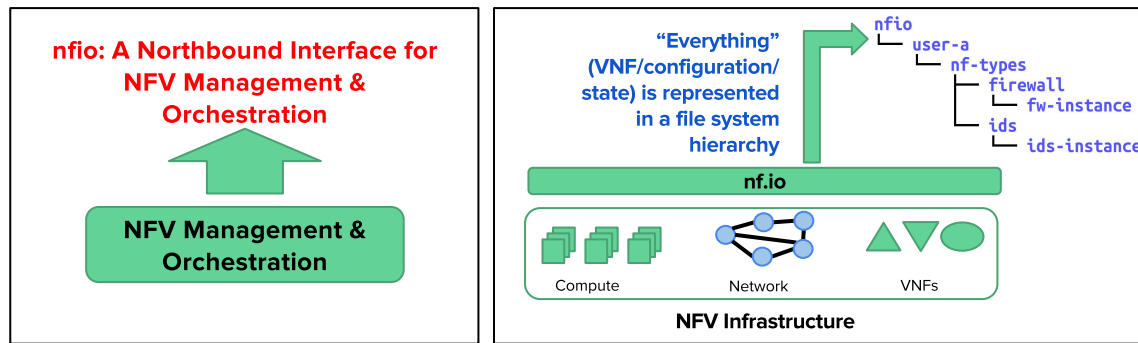


“Everything”
(VNF/configuration/
state) is represented in
a file system hierarchy



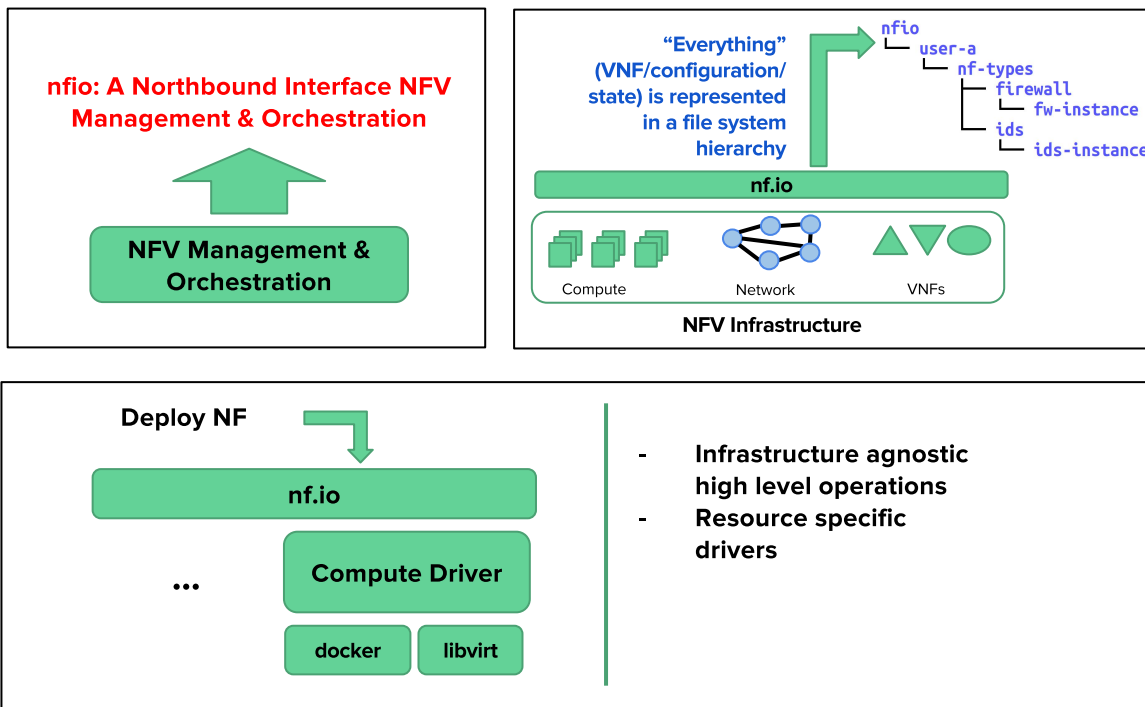
NFV Infrastructure

What is nf.io?



- Infrastructure agnostic high level operations
- Resource specific drivers

What is nf.io?



Related Work

- NFV Platforms
 - Stratos, OpenNF [SIGCOMM '14]
 - E2 [SOSP '15]
 - OPNFV
- File System Abstraction
 - Linux sysfs, procfs, cgroup
 - yanc [HotNets '13]
- Cloud Orchestrator
 - OpenStack, CloudStack, SaltStack

Why File System Abstraction?

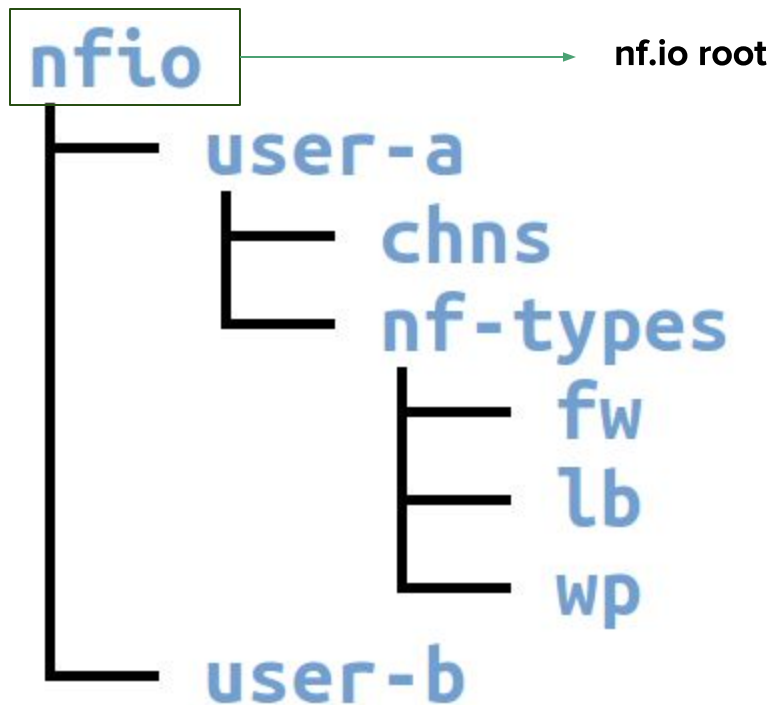
- Familiar tools to manage file systems
 - mkdir, cp, move, rm, rsync, etc.
 - grep, sed, awk, tail, etc.
 - e.g., instantiate a new VNF
 - `mkdir -p /vnfs/user-a/chain-b/ids`
- Rich set of file system management operations offered by configuration management tools such as Chef, Puppet, Salt etc.

Why File System Abstraction?

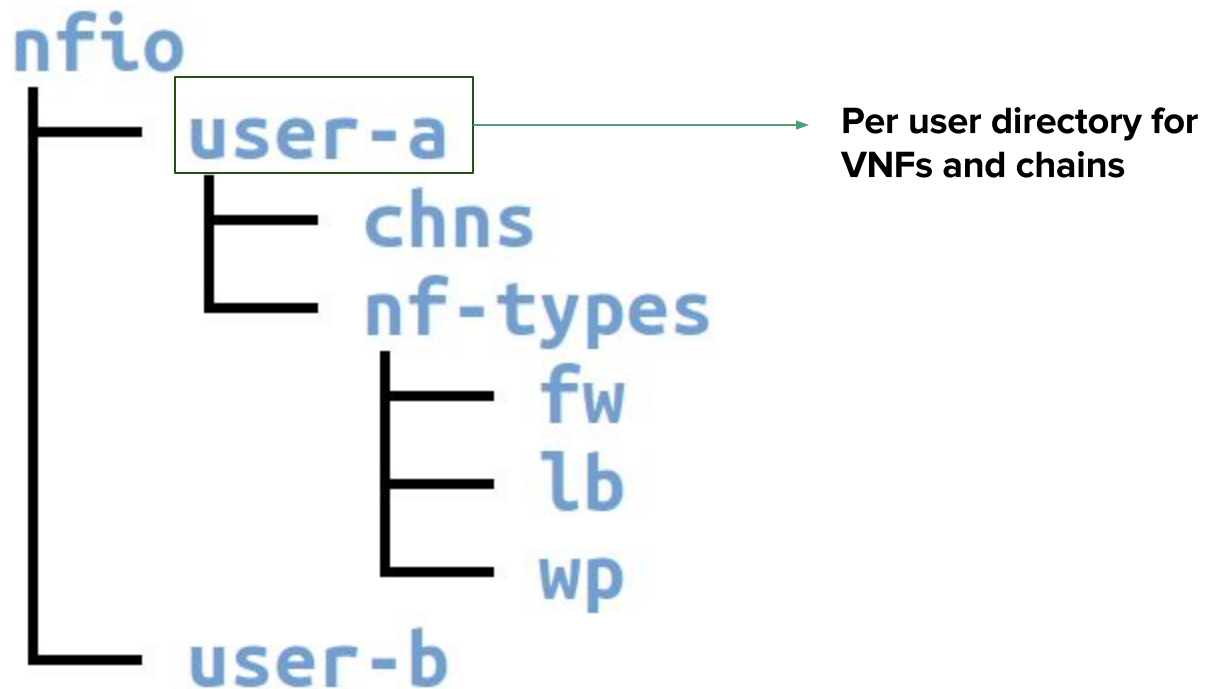
- Familiar tools to manage file systems
 - mkdir, cp, move, rm, rsync, etc.
 - grep, sed, awk, tail, etc.
 - e.g., instantiate a new VNF
 - `mkdir -p /vnfs/user-a/chain-b/ids`
- Rich set of file system management operations offered by configuration management tools such as Chef, Puppet, Salt etc.

Rich toolset around File Systems can be leveraged if we can translate NFV operations to File System Operations

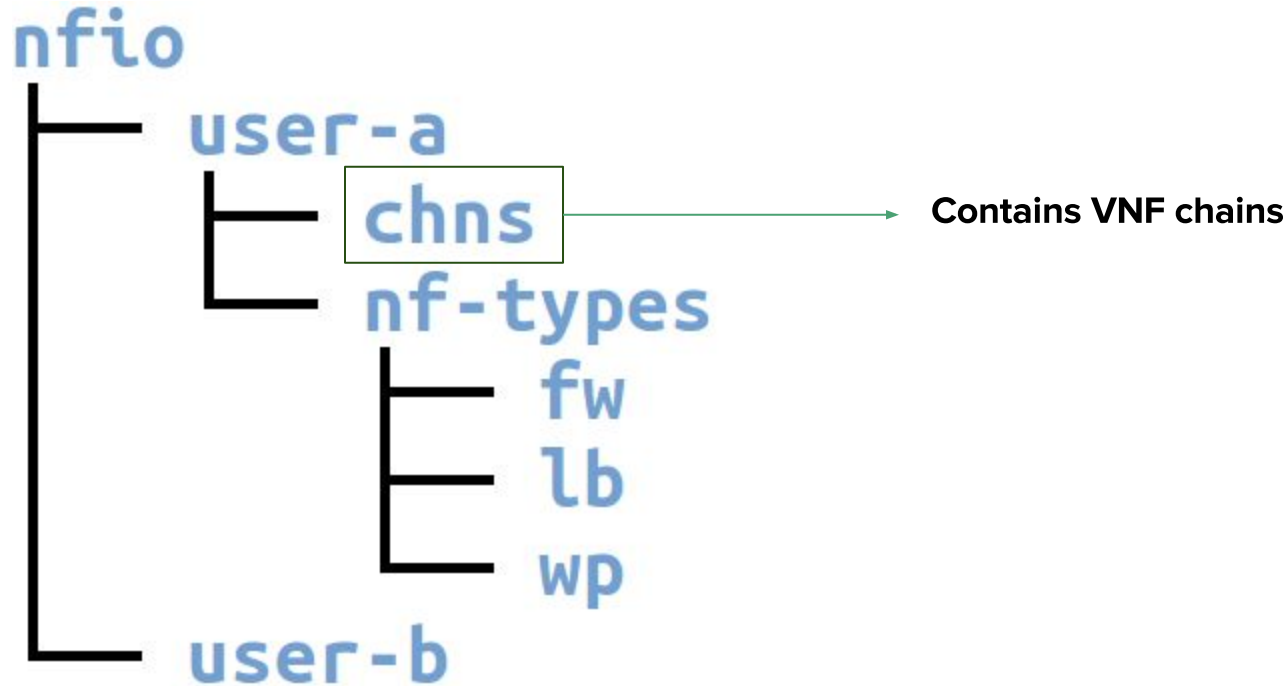
nf.io: File System Abstraction: High level



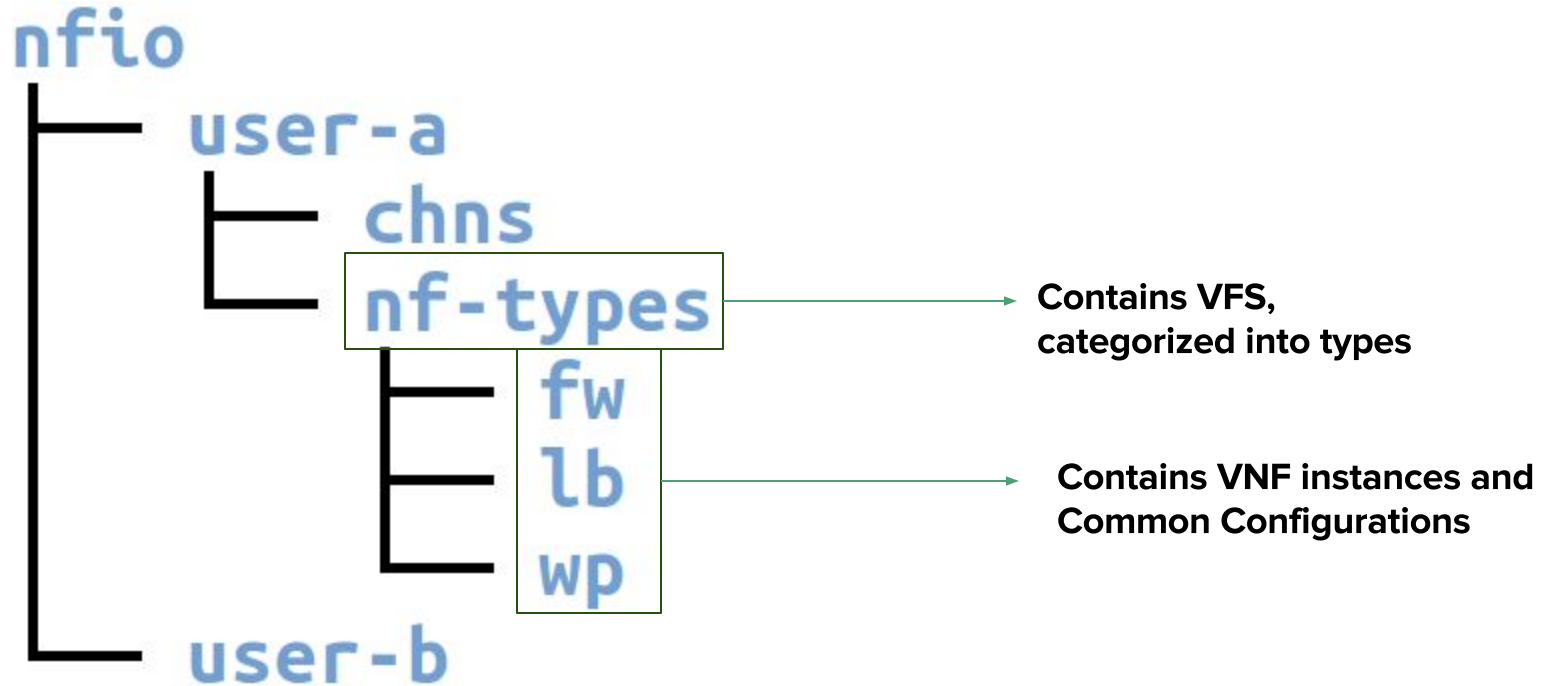
nf.io: File System Abstraction: High level



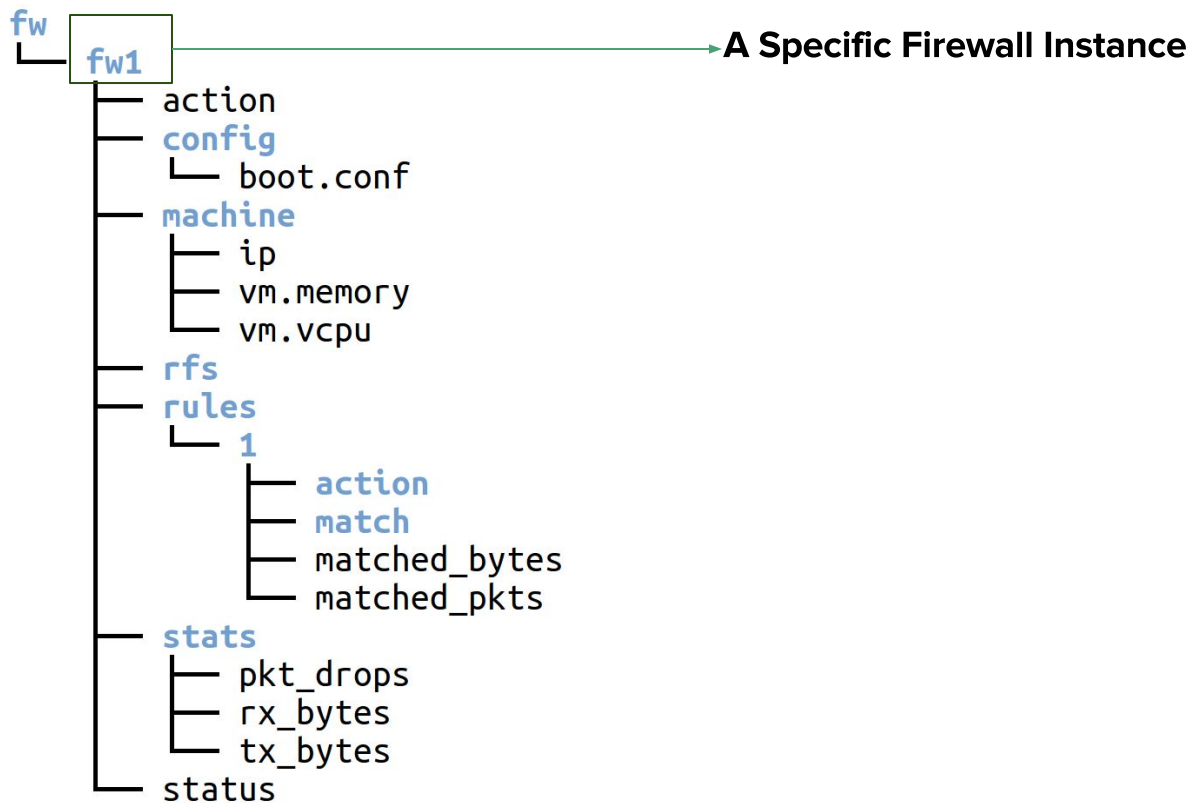
nf.io: File System Abstraction: High level



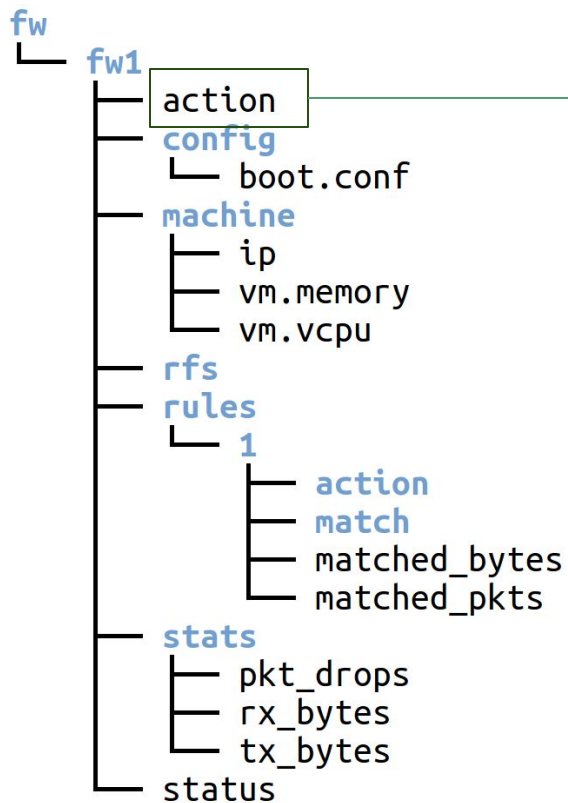
nf.io: File System Abstraction: High level



nf.io File System Abstraction: A Sample VNF

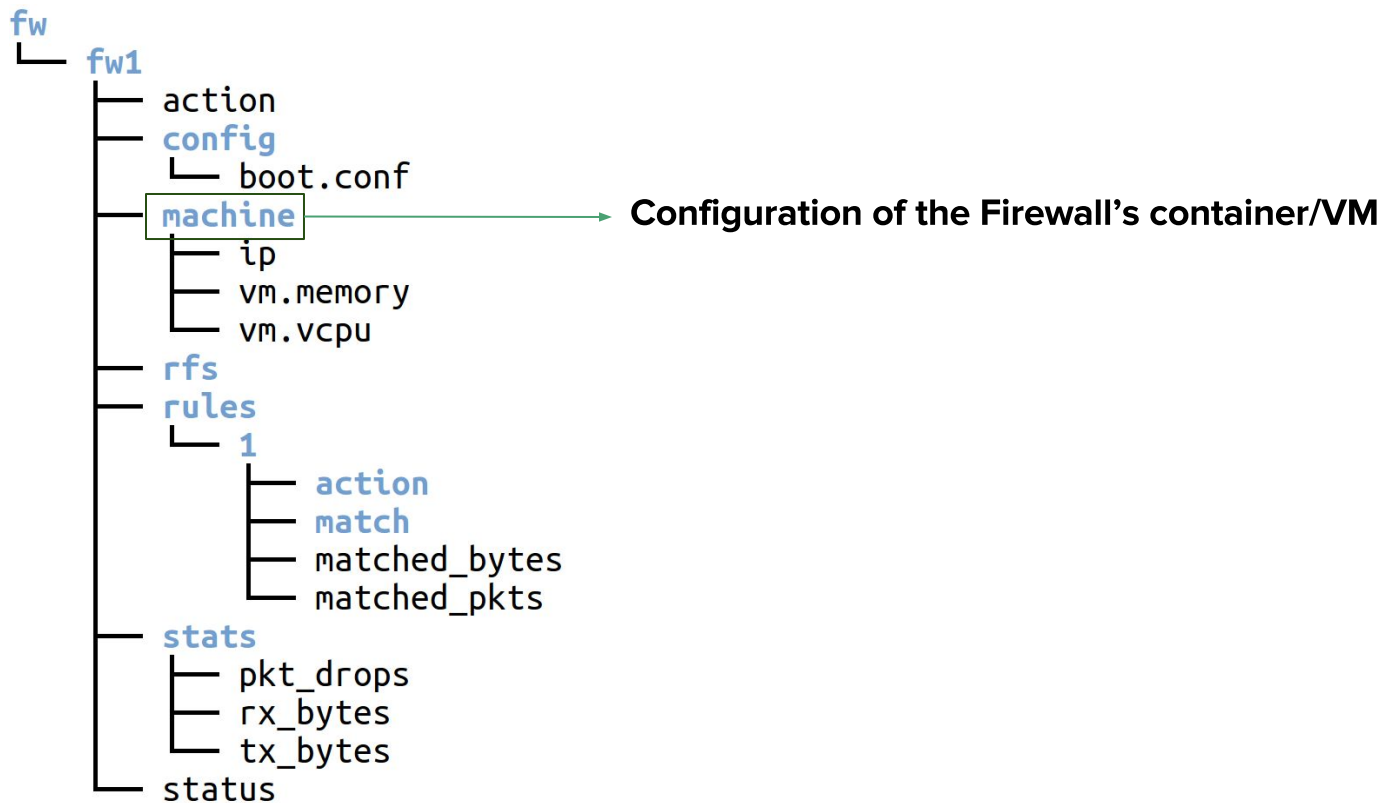


nf.io File System Abstraction: A Sample VNF

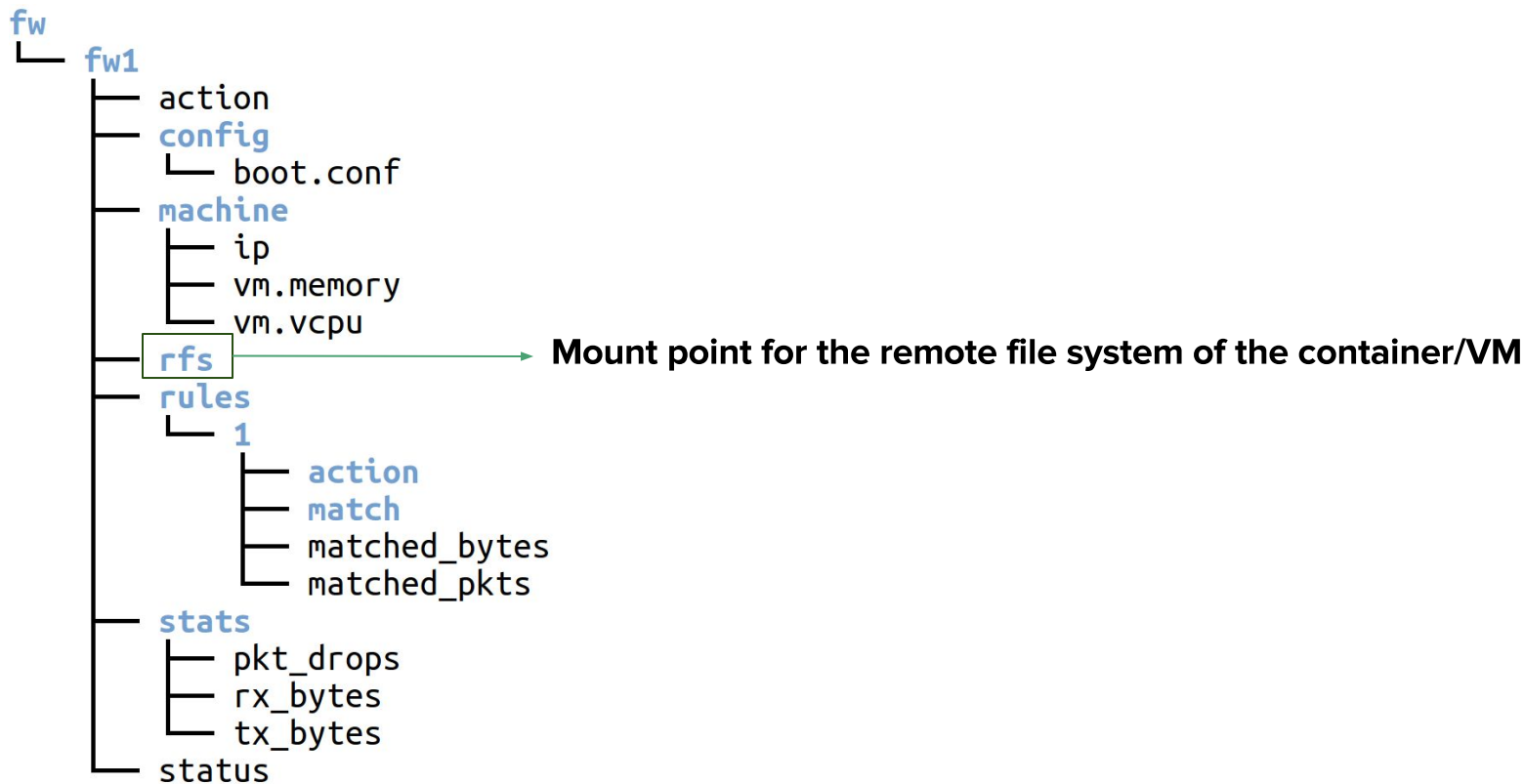


Writing “start” / “stop” here will
“start” or “stop” the Firewall

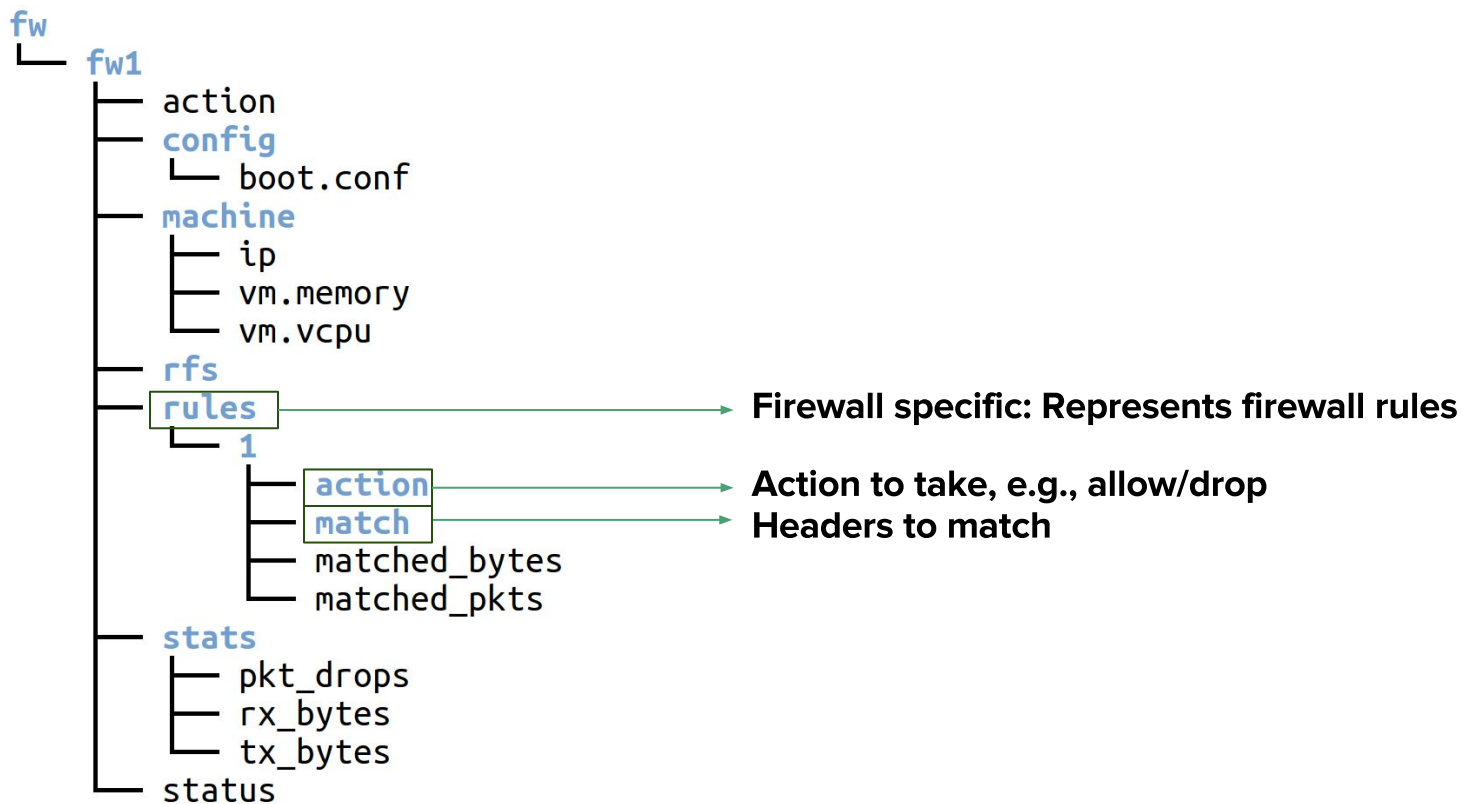
nf.io File System Abstraction: A Sample VNF



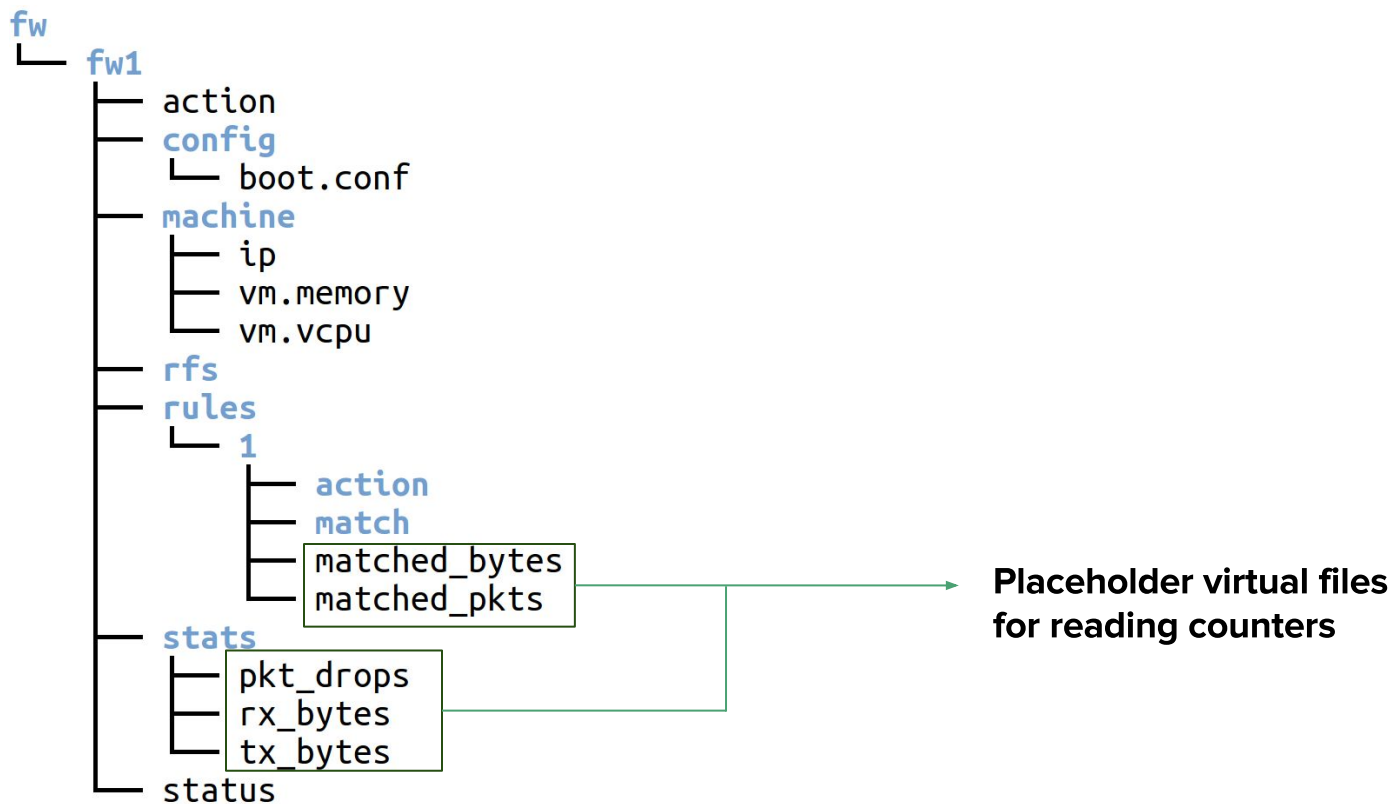
nf.io File System Abstraction: A Sample VNF



nf.io File System Abstraction: A Sample VNF

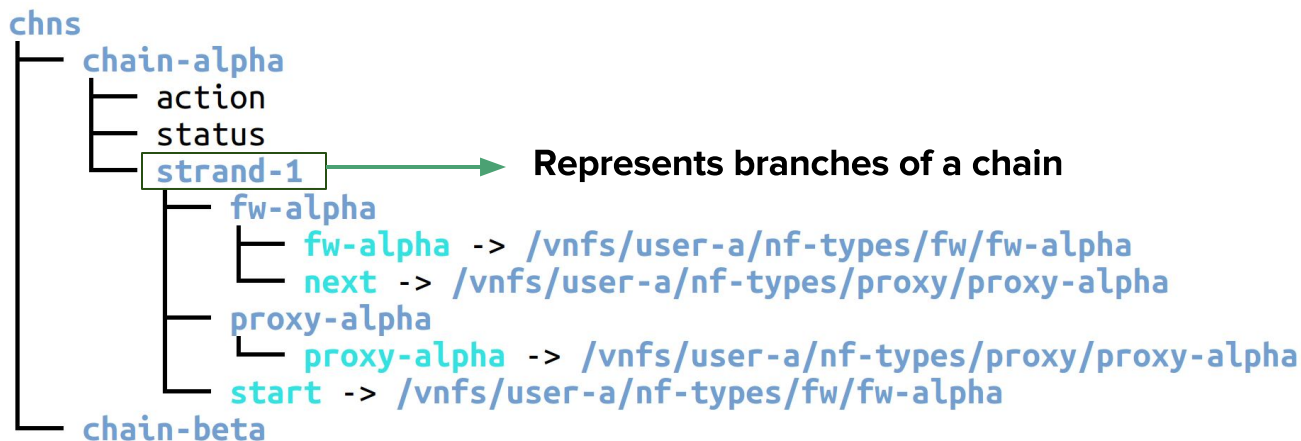


nf.io File System Abstraction: A Sample VNF

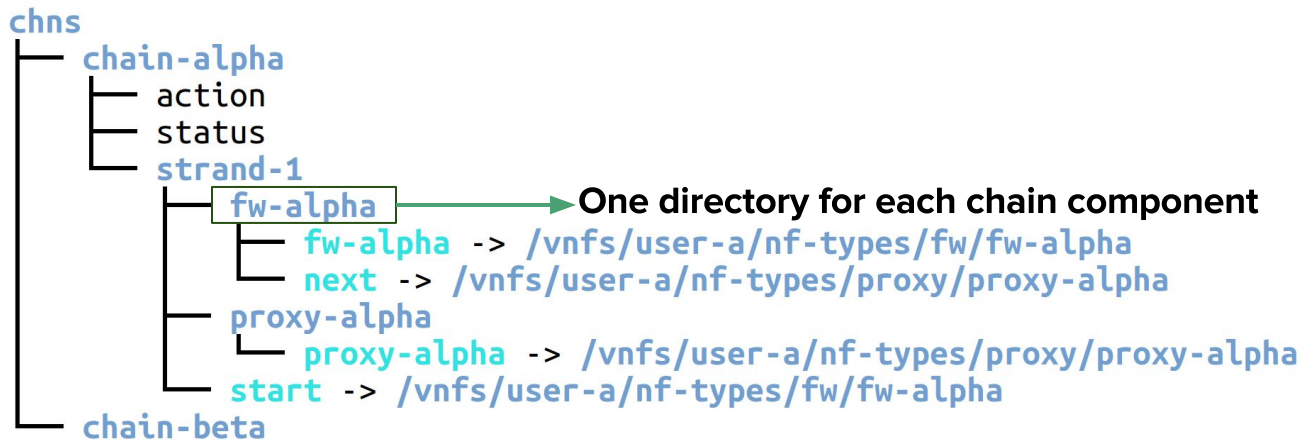


nf.io File System Abstraction: A VNF Chain

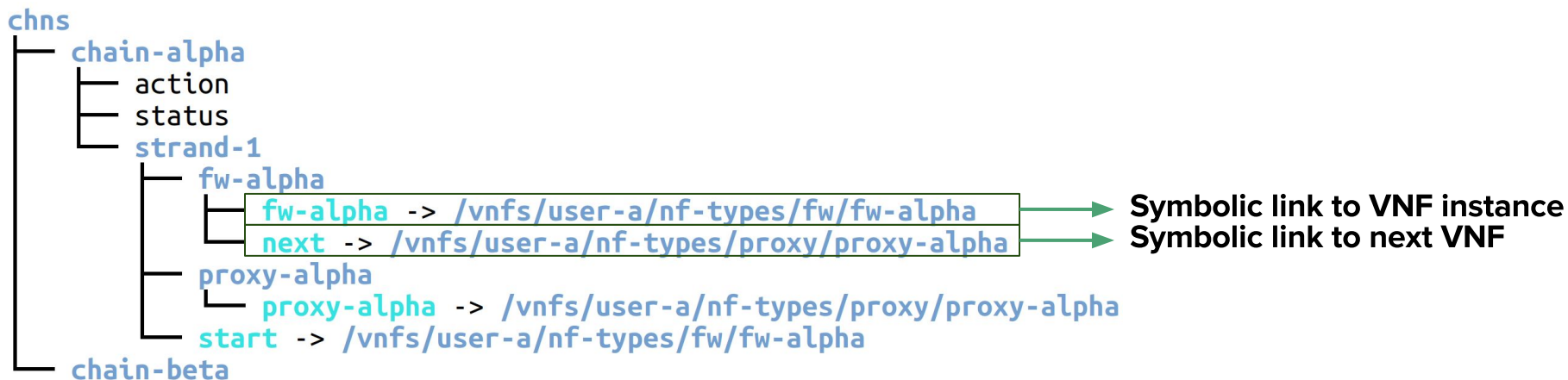
Example:



nf.io File System Abstraction: A VNF Chain

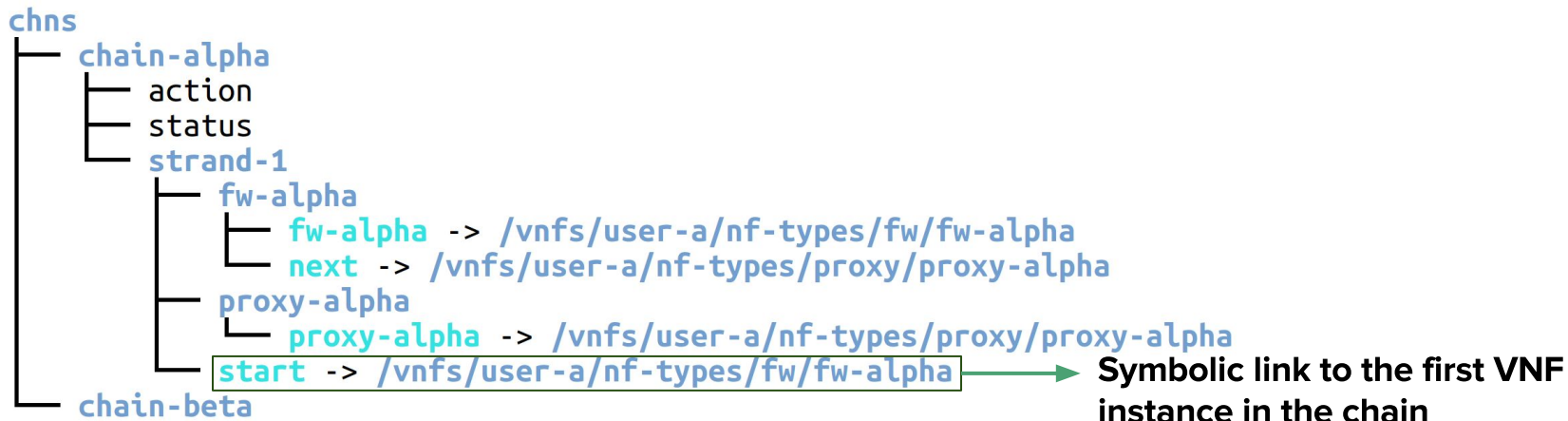


nf.io File System Abstraction: A VNF Chain



nf.io File System Abstraction: A VNF Chain

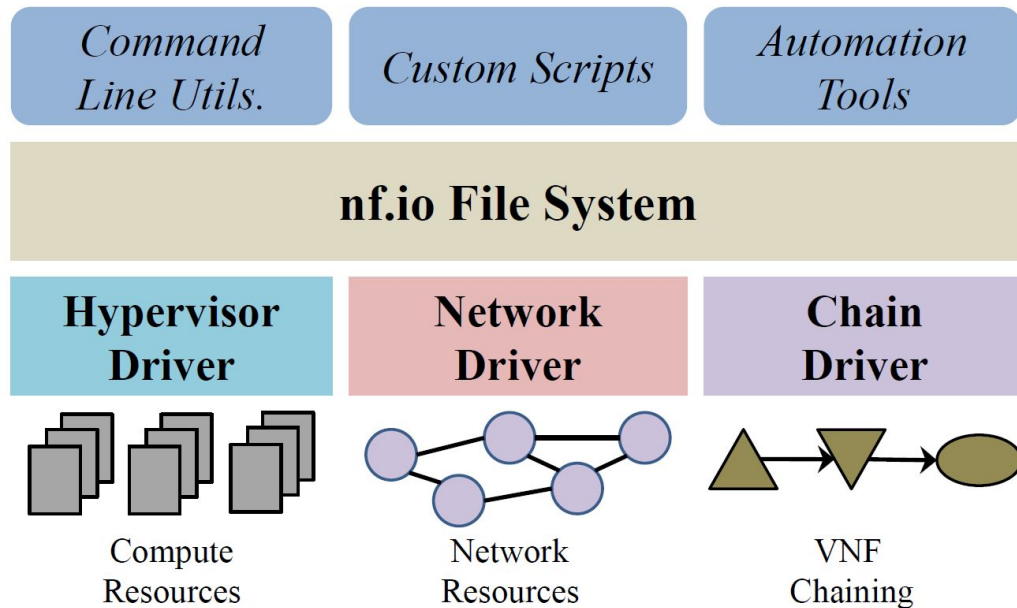
Example:



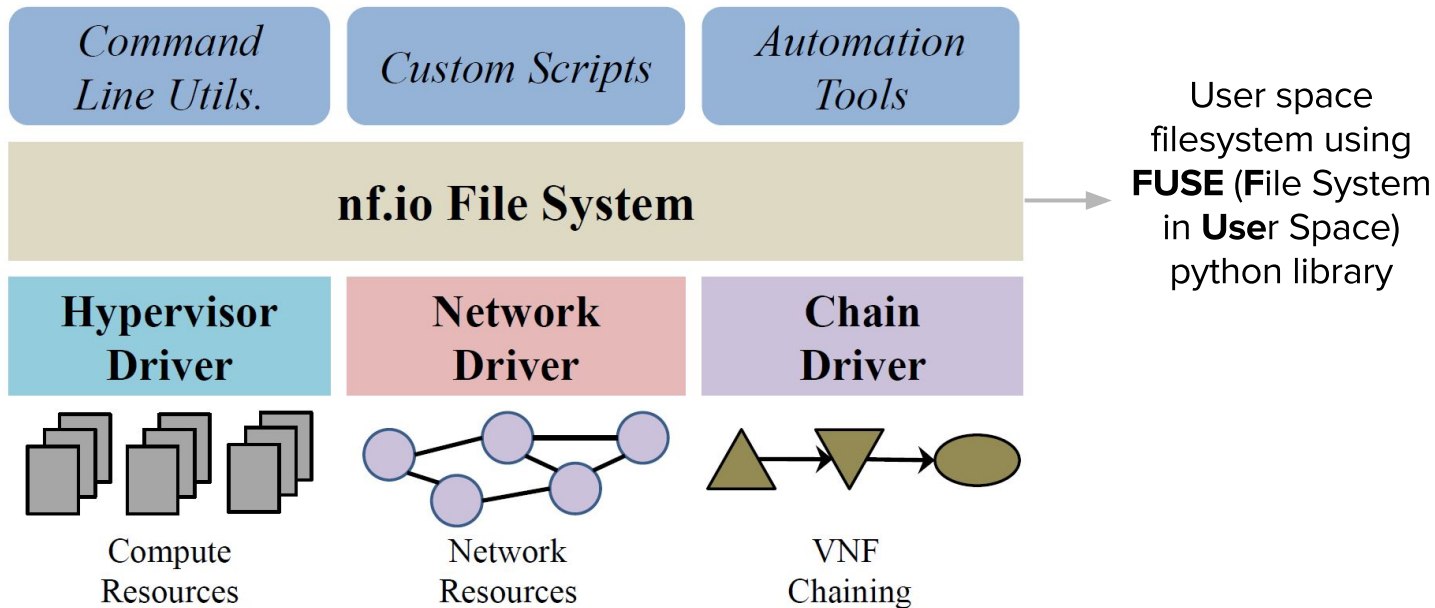
Sample Use Cases

- Deploy a VNF instance
 - `mkdir nf-types/bro/ids-a`
- Configure a VNF instance
 - Migrate a VNF instance to a different machine
`echo '10.0.0.15' > chns/chain-alpha/ fw-alpha/fw-a/machine/ip`
- Monitor
 - Total number of packet drops along a chain:
`find -L chns/chain-a pkt_drops | xargs cat | awk '{total += $1} END {print total}'`

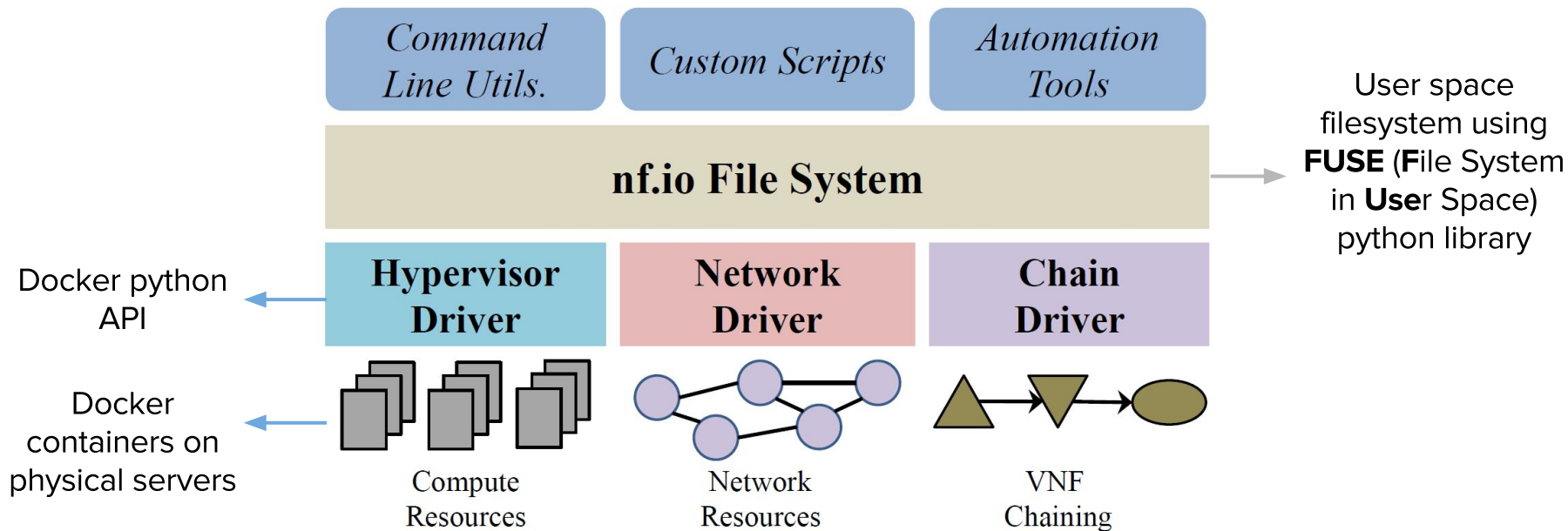
System Architecture



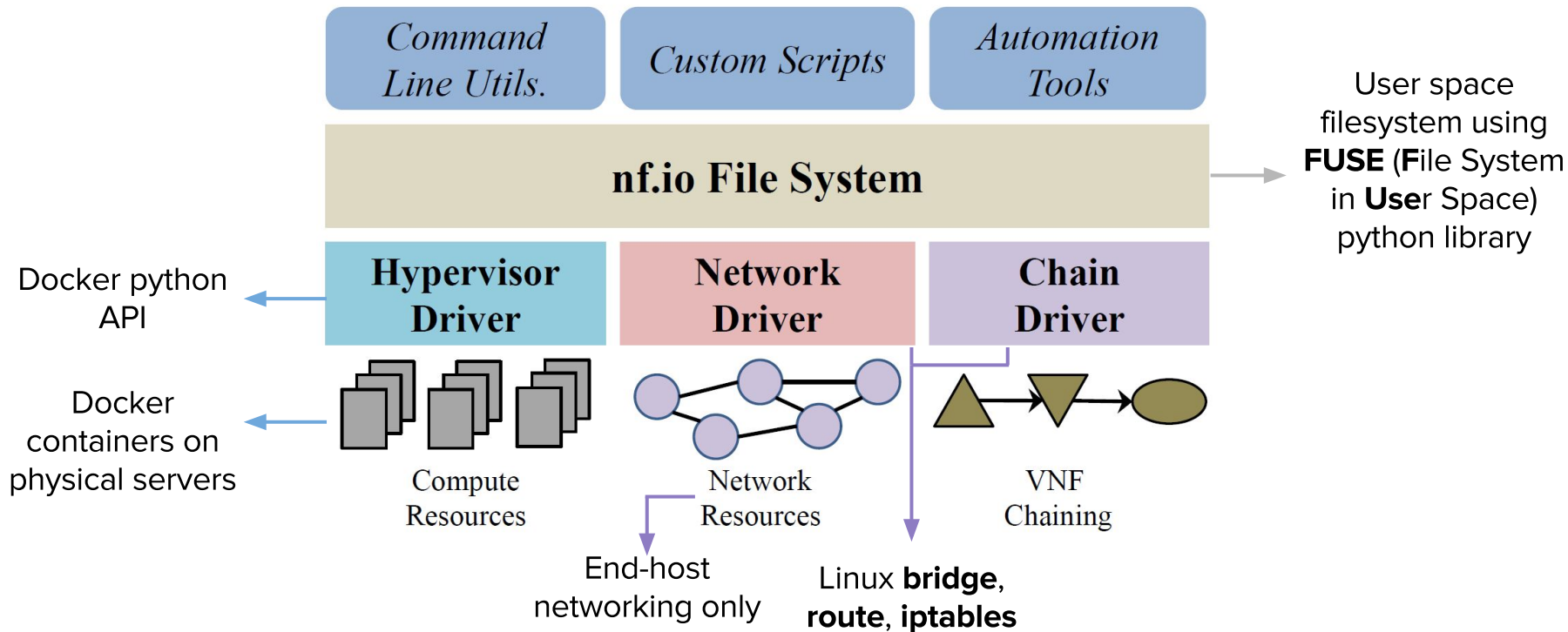
Prototype Implementation



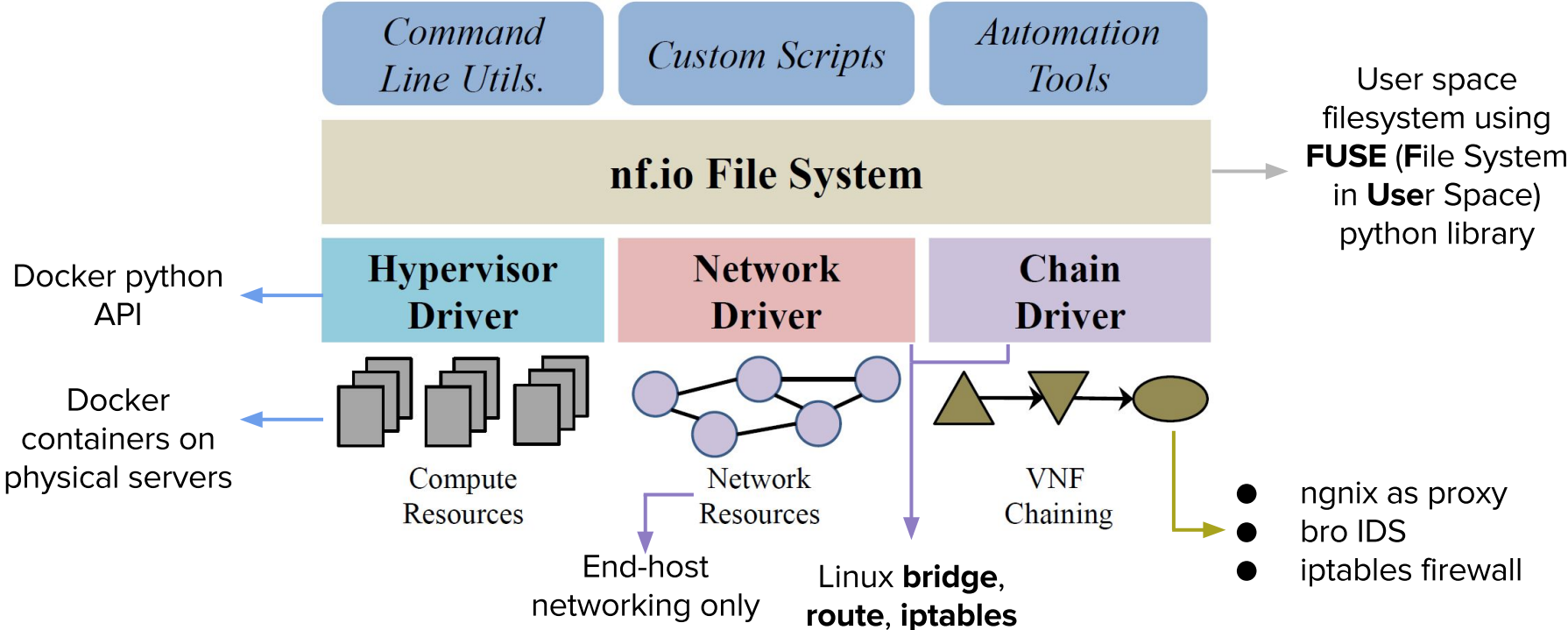
Prototype Implementation



Prototype Implementation



Prototype Implementation



Work In Progress

- Add support for VNF chains with branches
- Simplify VNF chain representation
- Open vSwitch for end-host data-path
 - Better Programmability
- Add more hypervisor support
 - Xen, KVM
- Integrate with OpenStack

Conclusion

- **nf.io**: A northbound interface for interacting with VNF Management and Orchestration Systems
- **nf.io** adapts the well known Linux File System abstraction
- **nf.io** allows high level infrastructure agnostic VNF operations
- Live demo of **nf.io**:
 - <http://faizulbari.github.io/nf.io/> (Link is also in the paper)
 - Try it out !

Questions?