How eBPF and XDP Will Revolutionize the Telco/5G Space

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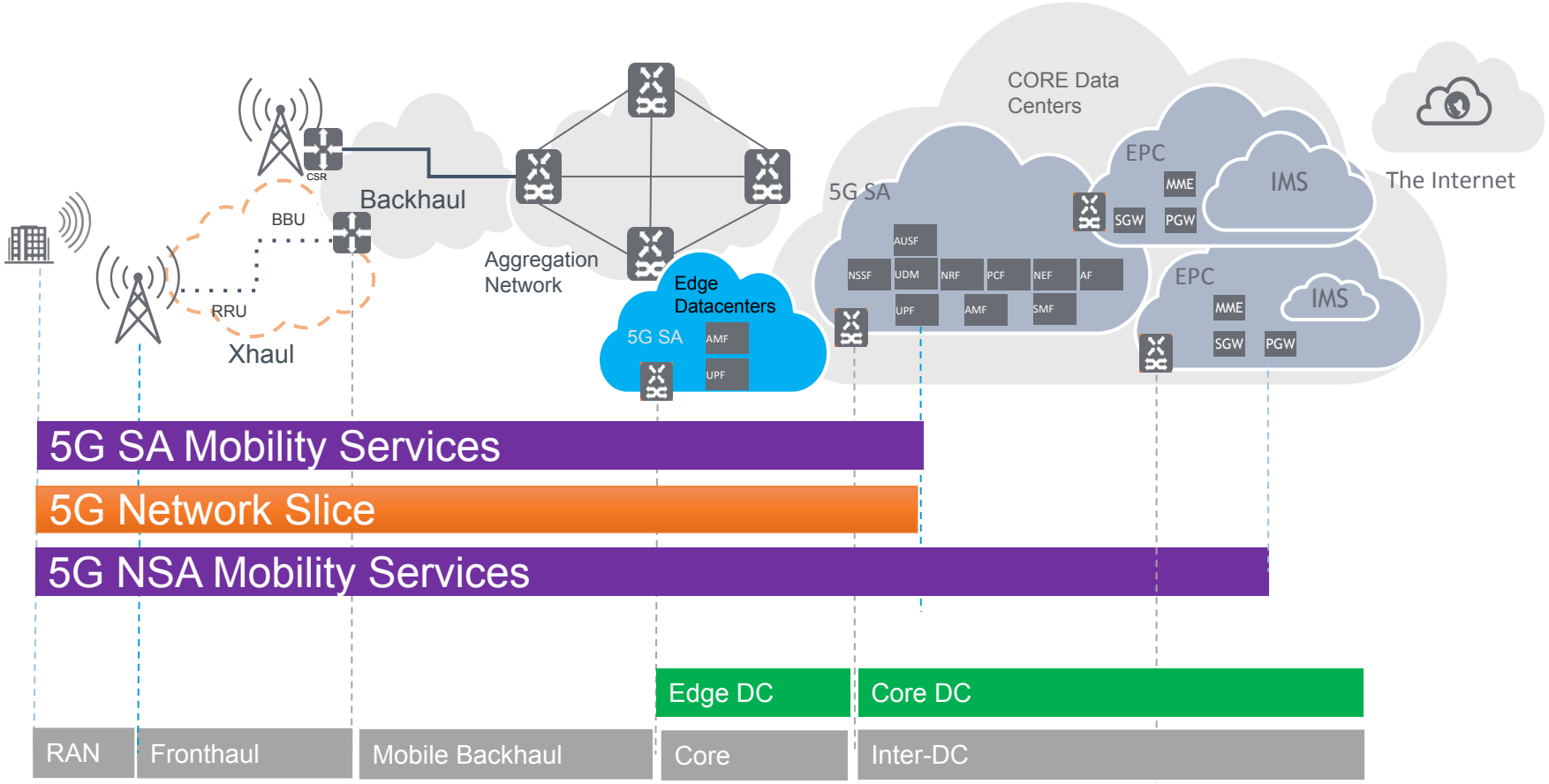
Thesis

3GPP 5G and O-RAN promised higher bandwidth, scale, new services and dramatic cost reductions in part through disaggregation of traditionally single source solutions.

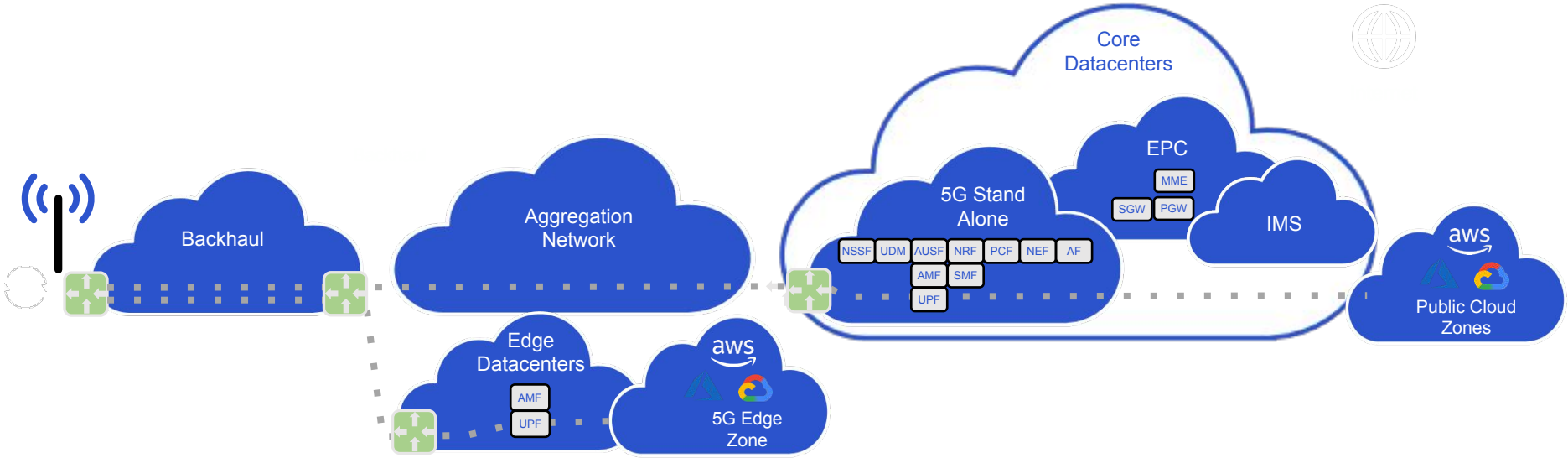
Can eBPF and XDP play a role to help make this a reality?

Quick 5G Overview

5G Mobile Deployment Areas



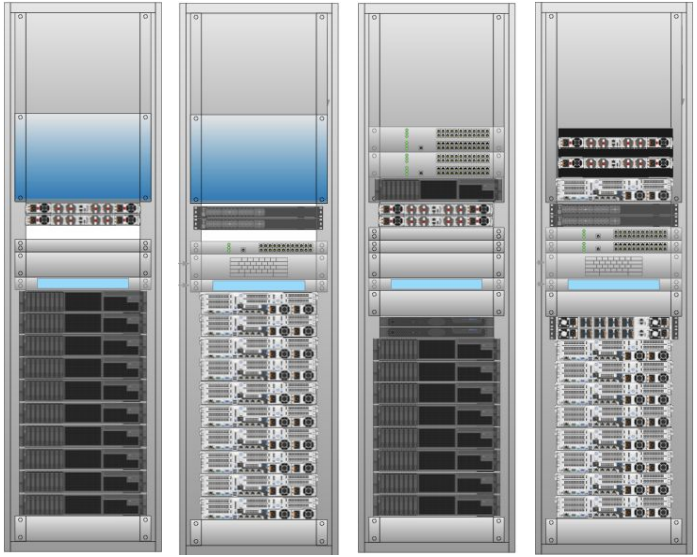
5G Deployment Complexity Moving to the Cloud



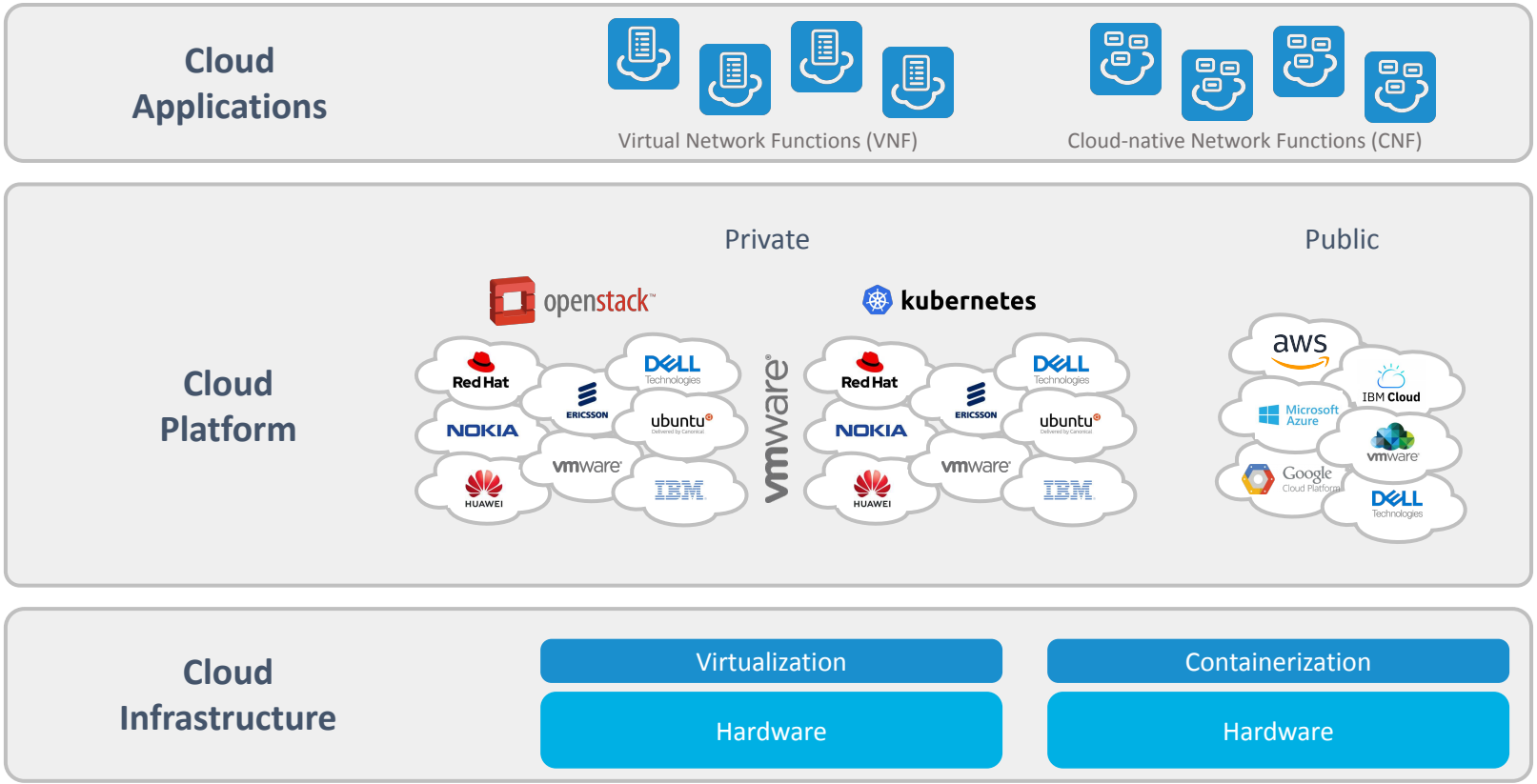
The Disaggregated 5G Approach and Its Hidden Complexities
Hardware

Traditional Single Vendor

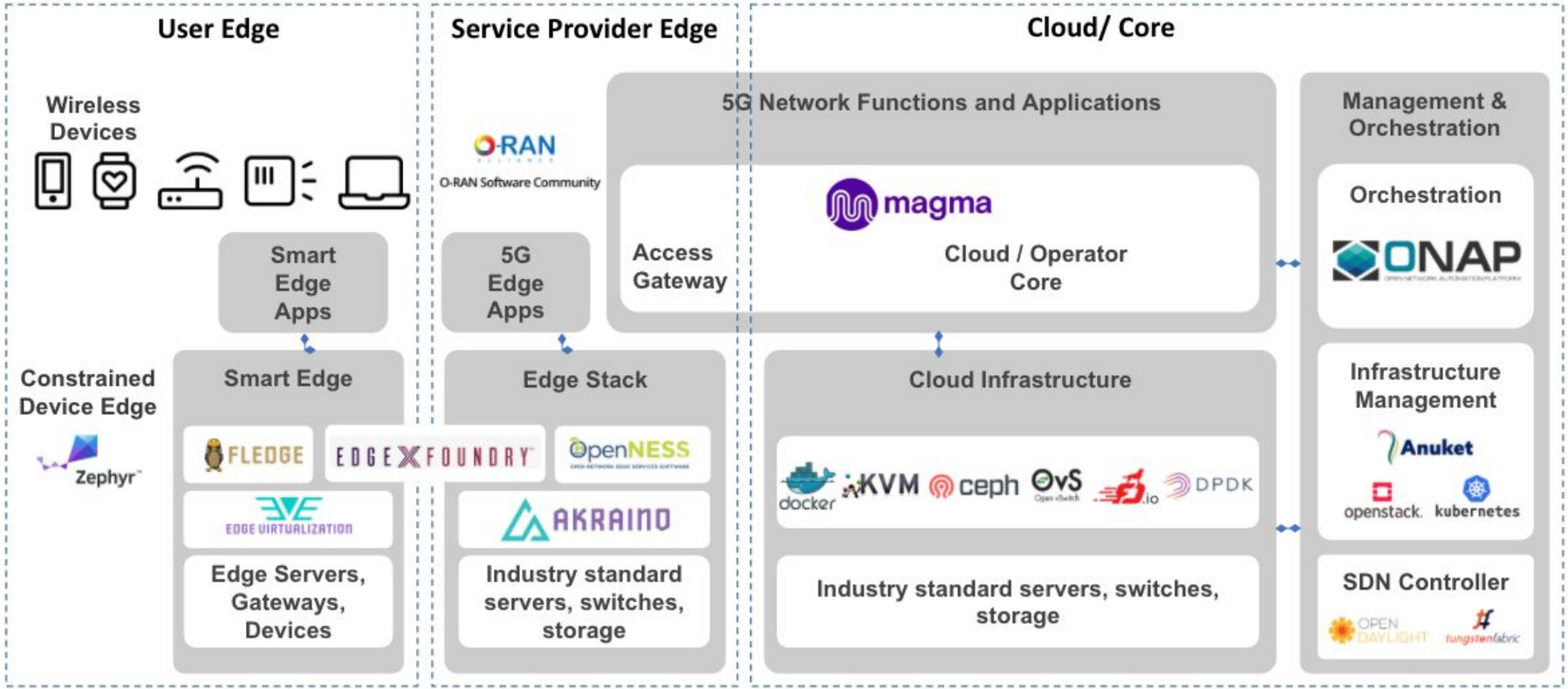
Disaggregated, Multi-vendor



The Disaggregated 5G Approach and Its Hidden Complexities
The Software Stack



LF Open Source Component Projects for 5G



eBPF + XDP

Overview

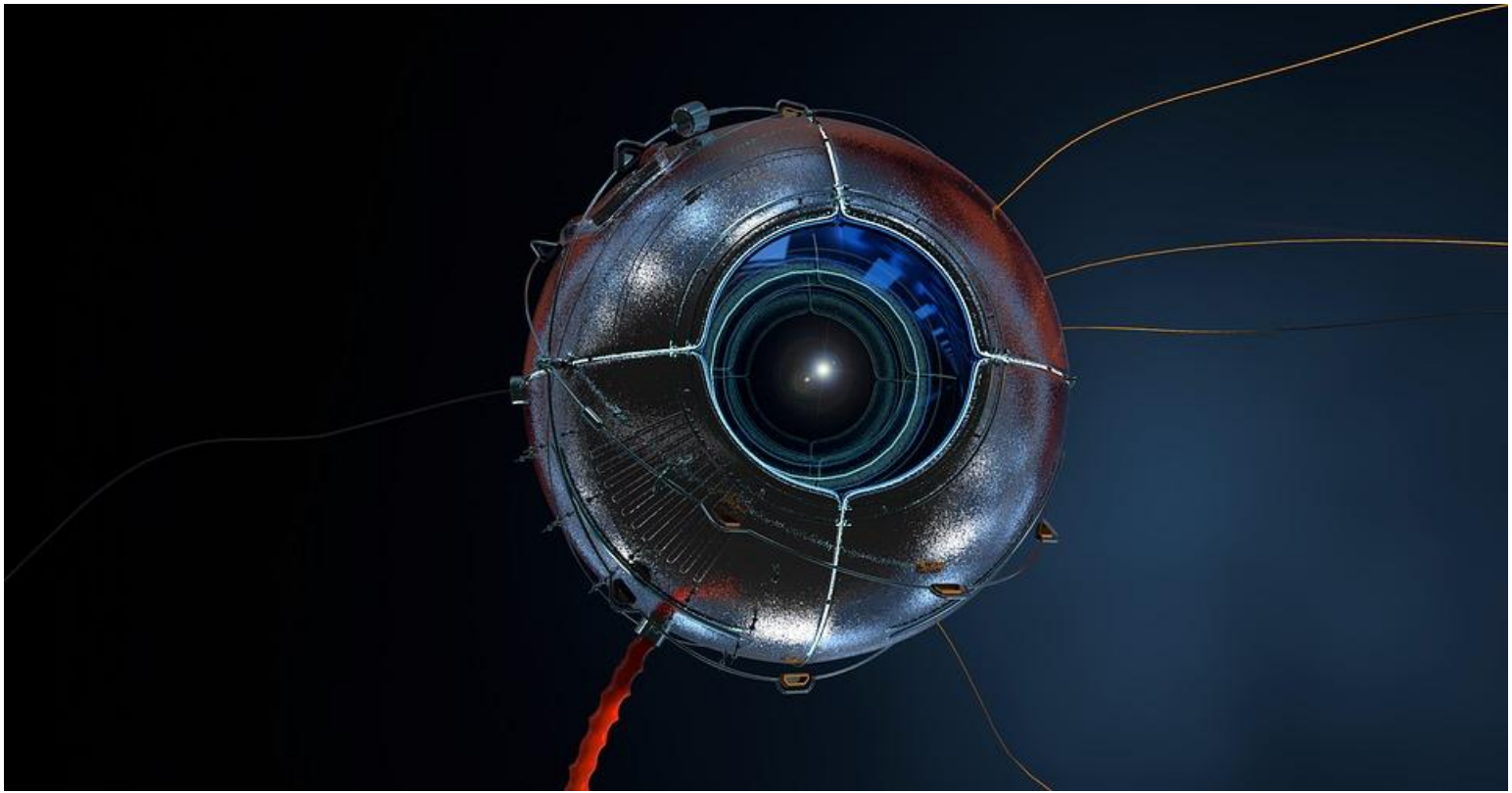
What is eBPF?

- Allows you to run sandboxed programs in an operating system kernel
- Goal: Allows users to extend the capabilities of the kernel without kernel source code changes
- Why:
  - The operating system is harder to evolve
  - Timelines for changes are longer
  - Security and stability requirements
- This means the rate of innovation is much slower at the operating system level

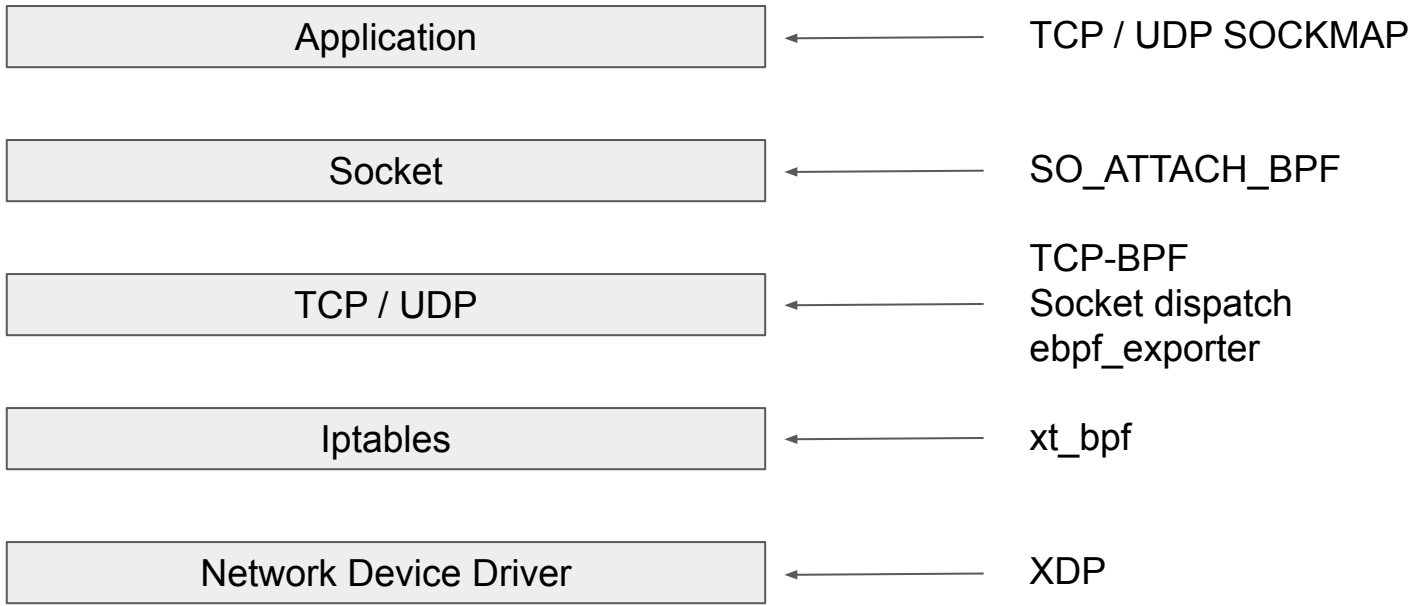
eBPF Use Case #1: Networking

eBPF Use Case #2: Security

eBPF Use Case #3: Observability and Tracing



eBPF Up And Down the Stack



Source: https://blog.cloudflare.com/cloudflare-architecture-and-how-bpf-eats-the-world/

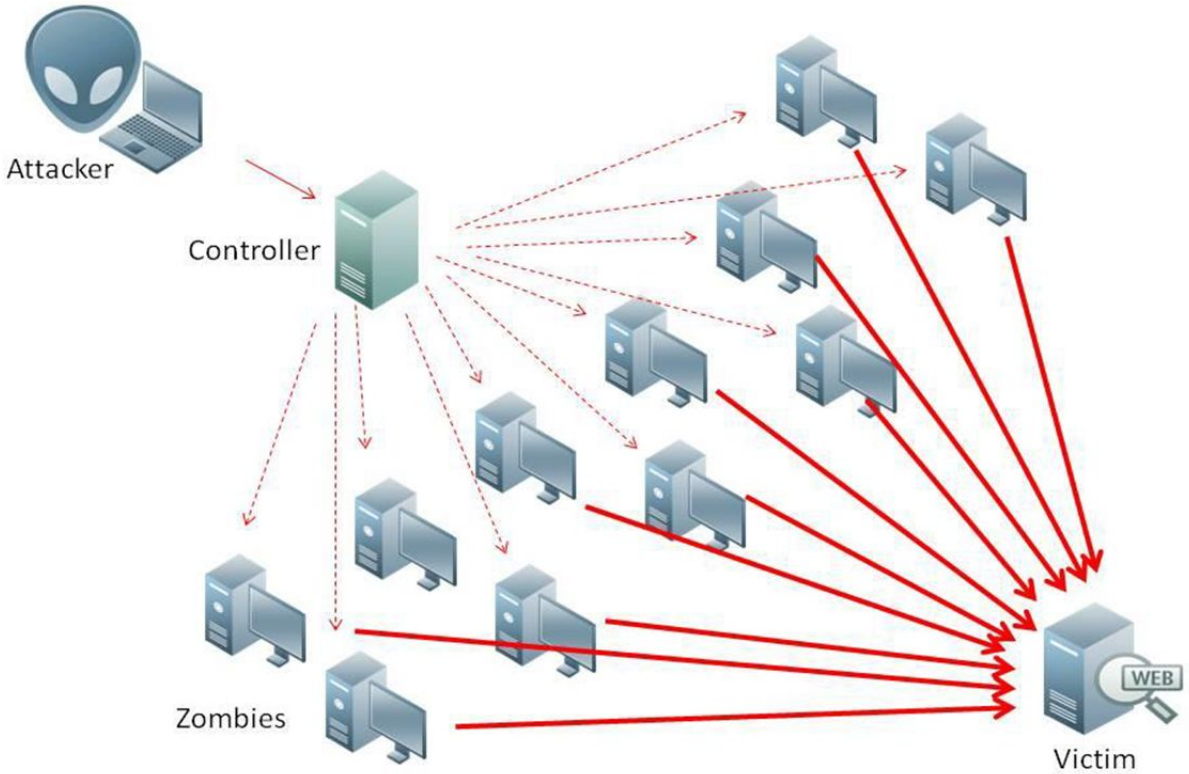
What Is Xdp?

Key XDP Features

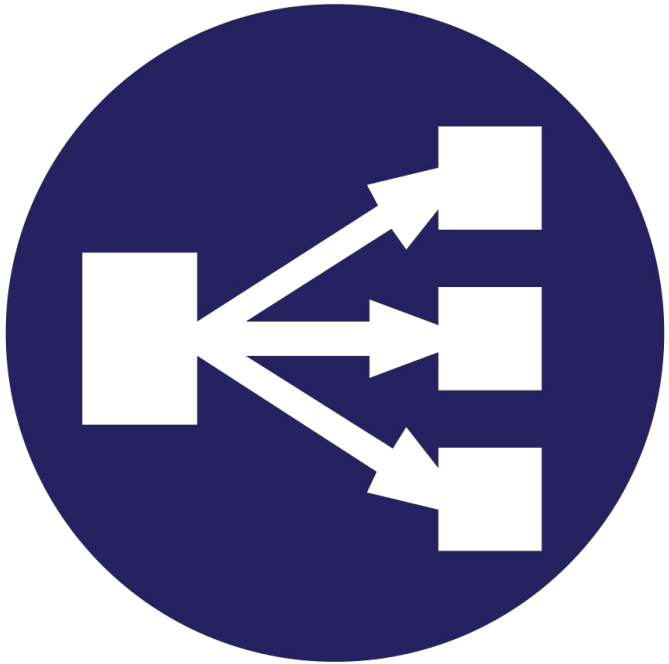
- Does not require any specialized hardware
- Does not require kernel bypass
- Does not replace the kernel TCP/IP stack
- Works in concert with the kernel TCP/IP stack
- Works hand in hand with all the benefits of eBPF programs

The Current Status of Telco Networking and eBPF/XDP

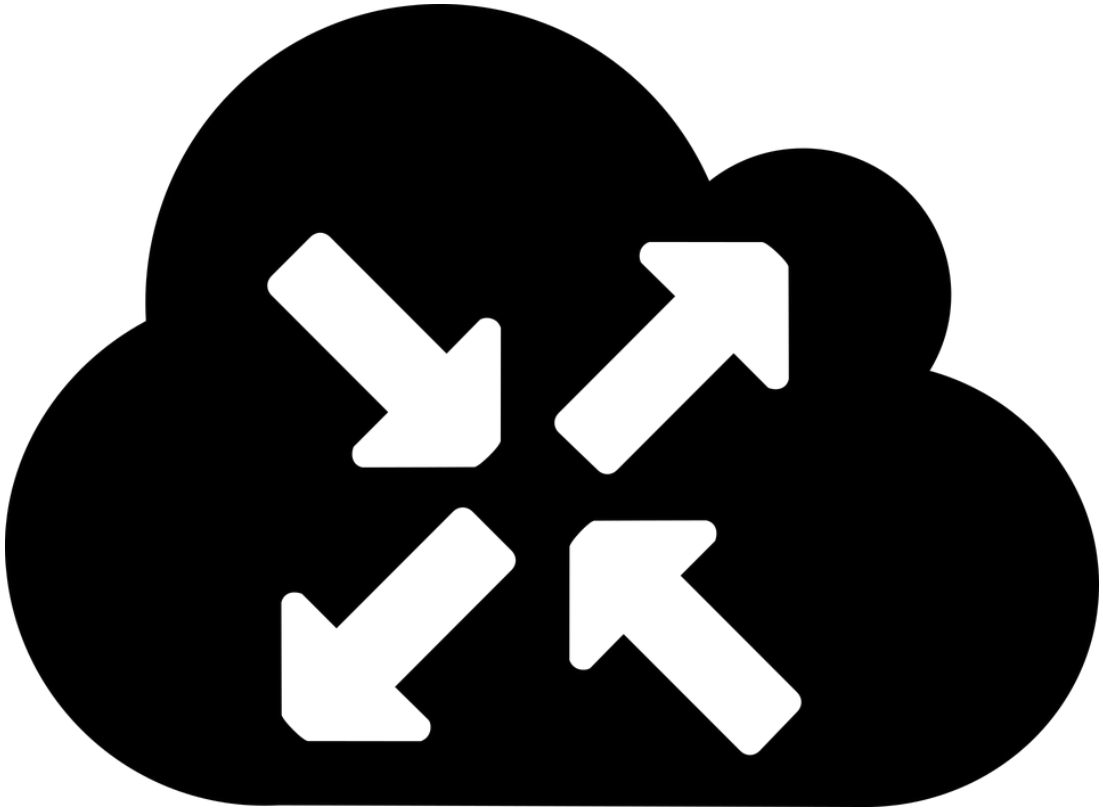
Use Case: DDoS Mitigation



Use Case: Load Balancing



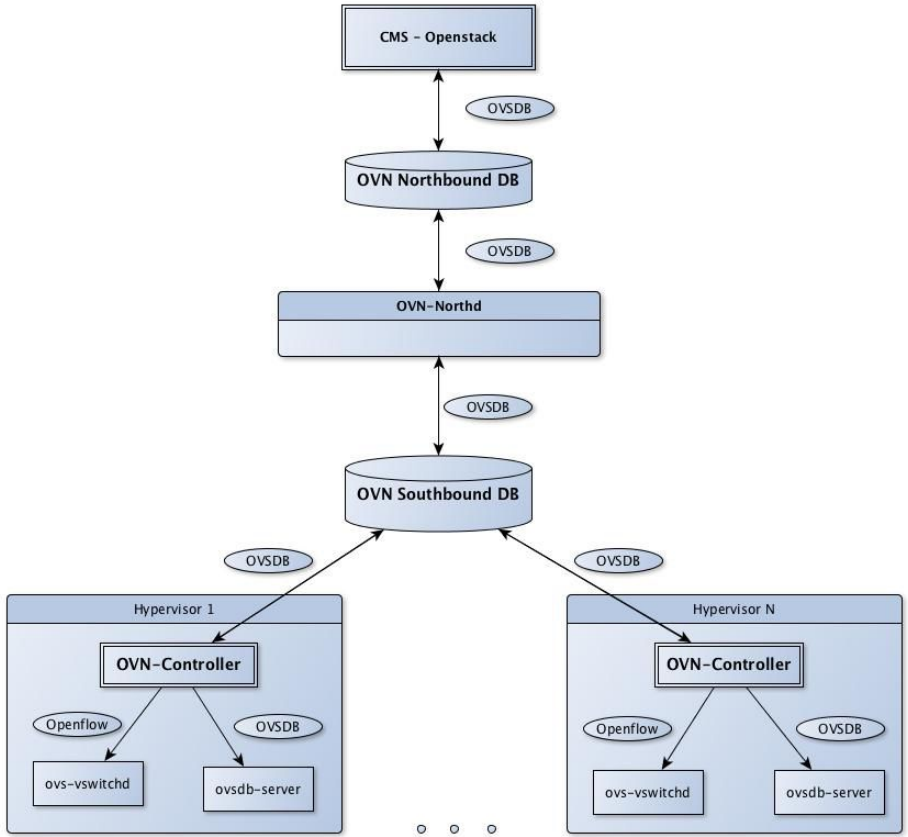
Use Case: High Performance Forwarding



Use Case: Flow Sampling and Monitoring

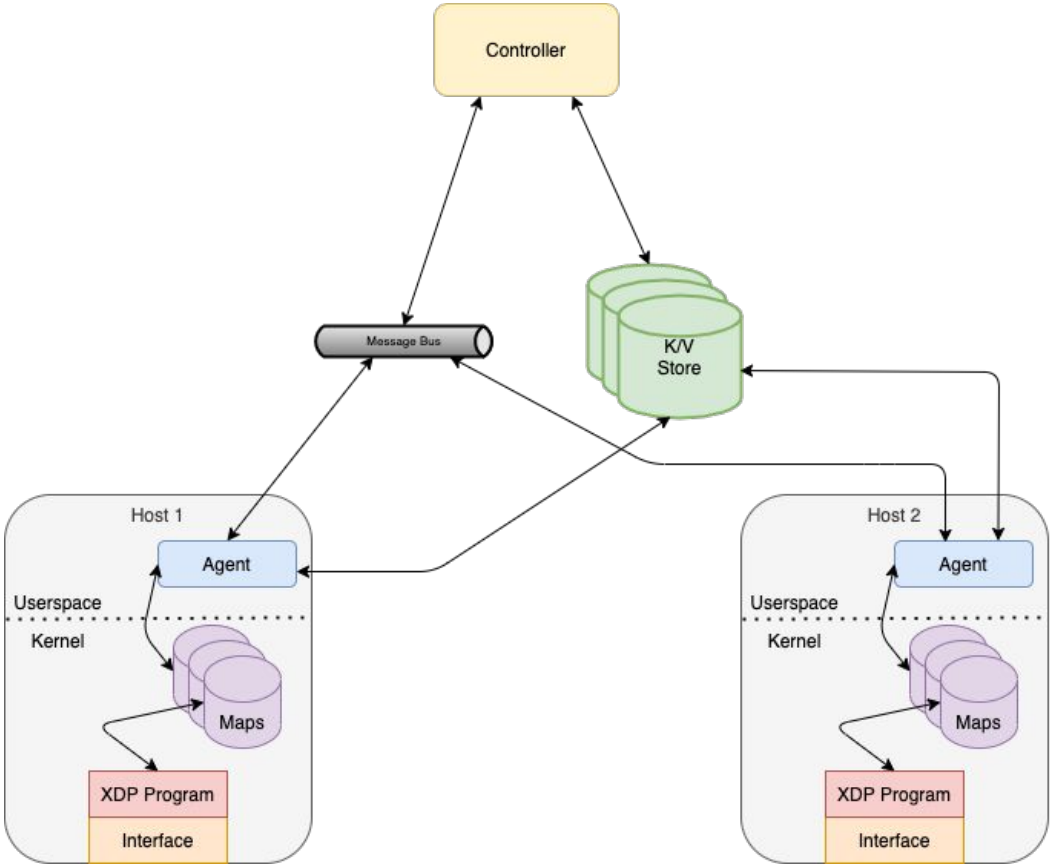
Comparing eBPF/XDP to OVN

OVN



Source: https://galsagie.github.io/2015/04/20/ovn-1/

eBPF/XDP


Controller
Message Bus
K/V
Store
Host 1
Agent
Userspace
Kernel
Maps
XDP Program
Interface
Host 2
Agent
Userspace
Kernel
Maps
XDP Program
Interface

OVN Compared to eBPF/XDP

- What Are You Building?
  - VM approach for network functions vs. built-in functions
-

Key Components of Successful Production Deployments of eBPF/XDP

Step 1: Hire the Right Team

Step 2: Ensure You Have Monitoring and Observability

Step 3: Understand How Upgrades Will Work

Step 4: State Is Your Enemy

Checklist For Running eBPF/XDP In Production

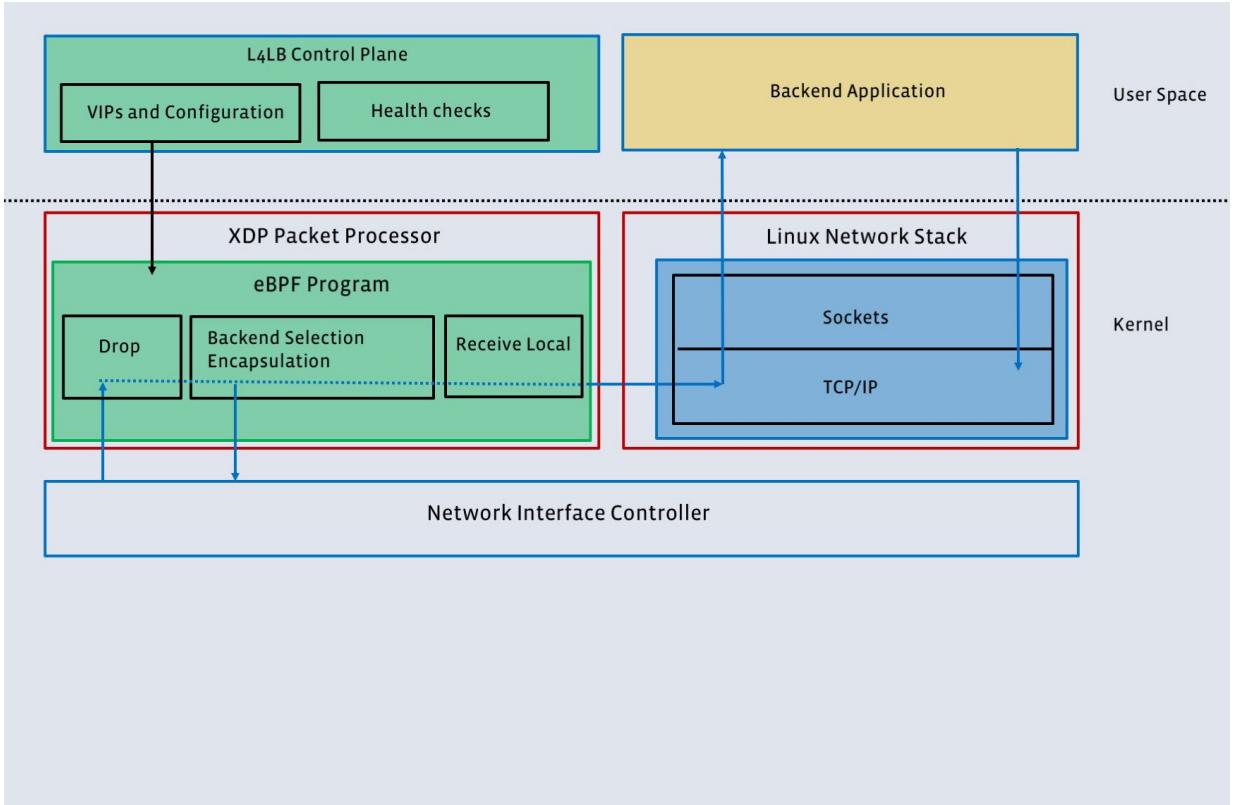
- Hire the right team
  - C programmers
  - SREs
  - Enable and empower the team
- Monitoring and observability of the solution
- Understand how upgrades will work
- State is your enemy

Charting the Future of Telco Networking and eBPF/XDP

eBPF/XDP Allows Further Disaggregation

- Decouple network functions into eBPF and XDP programs
- Run them as close to the hardware as possible
- Scale functions horizontally
- Begin to think in terms of streams (TCP) and datagrams (UDP and QUIC)

Example: Facebook Katran



Source: https://engineering.fb.com/2018/05/22/open-source/open-sourcing-katran-a-scalable-network-load-balancer/

Thesis: Answered

3GPP 5G and O-RAN promised higher bandwidth, scale, new services and dramatic cost reductions in part through disaggregation of traditionally single source solutions.

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THANK YOU