Linux
Plumbers
Conference

Richmond, Virginia | November 13-15, 2023

Buzzing Across Space

The Illustrated Children's Guide to eBPF

Quentin Monnet

<quentin@isovalent.com>

Greetings!

Quentin Monnet

@ Isovalent (Cilium)
bpftool maintainer
working with eBPF since 2016

Understand eBPF (then):

Whirl Offload

Posts by date   Posts by category   About

Dive into BPF: a list of reading material

Sep 1, 2016 • Quentin Monnet
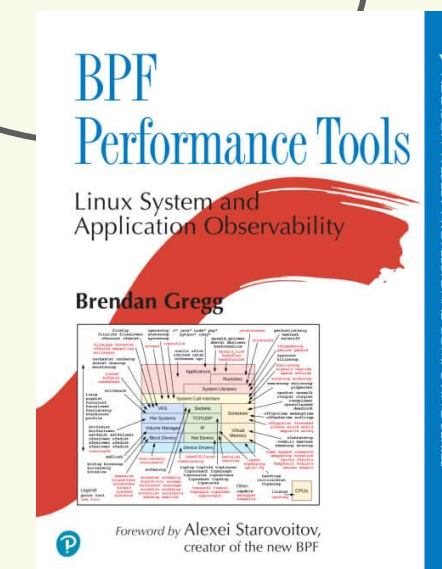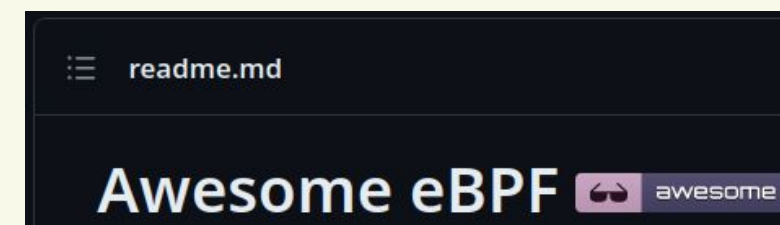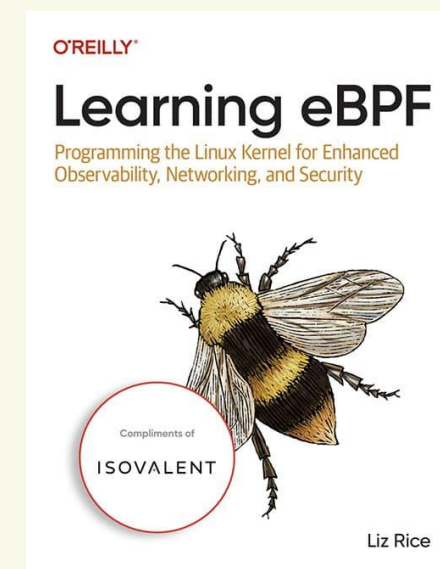
◀ Table of contents

~ *Updated* 2019-01-10 ~

What is BPF?

BPF, as in **B**erkeley **P**acket **F**ilter, was initially conceived in 1992 so as to provide a way to filter packets and to avoid useless packet copies from kernel to userspace. It initially consisted in a simple
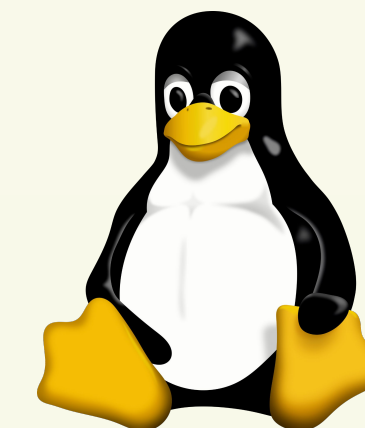
Understand eBPF (now)

eBPF.io

Blog posts

xdp-project / xdp-tutorial

Learning eBPF
O'REILLY
Programming the Linux Kernel for Enhanced
Observability, Networking, and Security

Compliments of
ISOVALENT
Liz Rice

readme.md
Awesome eBPF

BPF
Performance Tools
Linux System and
Application Observability
Brendan Gregg

Foreword by Alexei Starovoitov,
creator of the new BPF

Linux
Plumbers
Conference

Read docs,
source

eBPF newcomers

"I know Linux,
I hear I can use eBPF"

Advanced level

"How do I improve
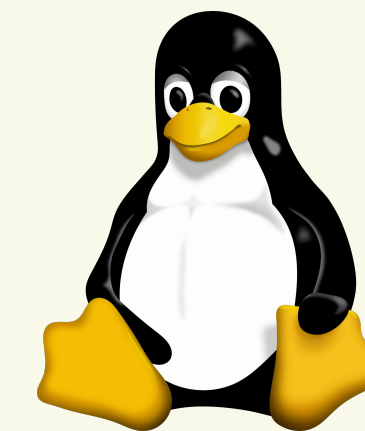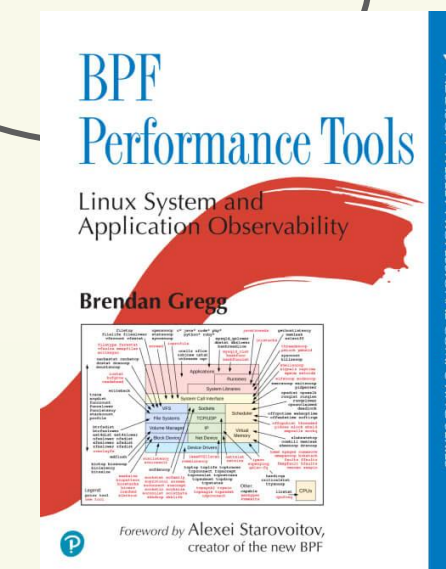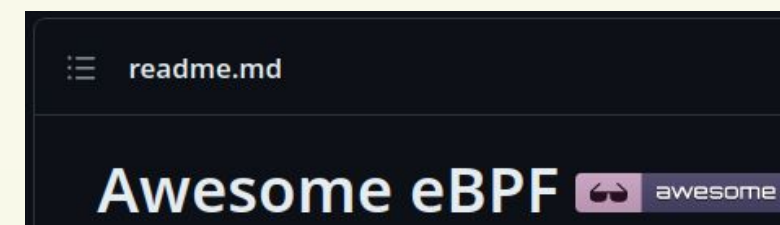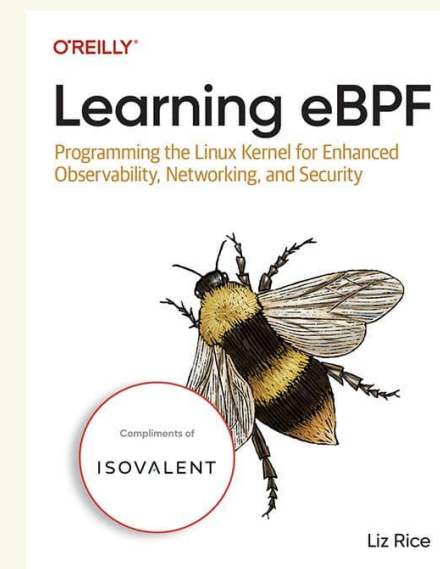the verifier?"

Understand eBPF (now)

eBPF.io

Blog posts

xdp-project / xdp-tutorial

?

Learning eBPF
Programming the Linux Kernel for Enhanced Observability, Networking, and Security

Compliments of
ISOVALENT

Liz Rice

readme.md

Awesome eBPF

BPF Performance Tools
Linux System and Application Observability

Brendan Gregg

Foreword by Alexei Starovoitov,
creator of the new BPF

Linux
Plumbers
Conference

Read docs,
source

My daughter

"What is the bee for?"
or
"I've heard I can program
the kernel with eBPF.
Hey, what's a kernel?"

eBPF newcomers

"I know Linux,
I hear I can use eBPF"
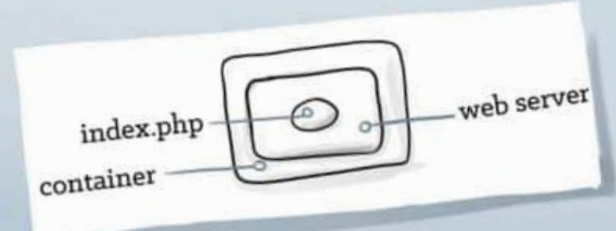
Advanced level

"How do I improve
the verifier?"

A children's guide to Kubernetes

Illustrated

The Children's Guide to Kubernetes

Containers

- Need to be managed
- Networking is hard
- Containers must be scheduled, distributed, and load balanced
- And the data's got to persist *somewhere*

index.php
container   web server

https://phippy.io/

BUZZING ACROSS SPACE
THE ILLUSTRATED CHILDREN'S GUIDE TO EBPF

Far away, beyond skies, asteroids, and dust,
The Silver Lining flew between the nebulae.
On the front deck, at the commands, was Captain Tux,
Who carried passengers across the galaxy.

While the crew, hard at work, assisted their captain,
All the travelers enjoyed comfort, peace, and leisure.
But forbidden to all was the cramped engine room,
Its critical systems of metal and fire.

Flying for years across the galaxy and back,
The crew learned to modify their ship and adjust.
They changed the thrusters, the force shields, the hyperstack,
To explore the most exotic worlds, and beyond.

But it's tough and discouraging to upgrade systems
In the vacuum of space, or on an aquatic moon.
Captain Tux needed a fast way to replace items,
Adapt quickly, meet demand, and make business boom.

One day, a concerned Captain Tux reviewed the crew
And remembered that bees had long been aboard,
Working quietly, even if their chores were few.
Captain Tux had a flash; they'd no longer get bored!

"You are small enough", he said to their spokesbee,
"To fly straight to the engine room and work from the inside."
"Would you like to assist?" "Of course", answered eBee,
"We wish to help, to innovate, and we're on your side!"

Bees of various talents took many roles in the hive.
There were scientists, teachers, switchboard operators,
Electricians, explorers, even a detective.
They suited up and passed the airlock to the motors.

The engines were smokey and some bees were afraid
To damage the engines or just to block a cog.
"Fear not" said Captain Tux, "I will come to your aid":
He trained them and made sure they could see through the smog.

Captain Tux soon heard of possible improvement options.
eBee's fellows were zealous bees, aiming for speed:
"We'd go faster, for sure, with buzz code instructions."
"This would be much simpler for us to parse and read."

With his laser screwdriver and a bit of copper,
Captain Tux built a sturdy translator droid,
And the buzzing bees worked swifter than ever.
They organized as teams, and eBee took the lead.

Acquiring a new taste for engine room hacking,
The bees developed their activities more and more.
In the narrow spaces, they began creating
A real workshop, with shelves, tools, and gathered lore.

The shelves were great to store all sorts of materials,
So that one bee could pass their product to the next.
The tools would help reuse the engine's internals
To unlock and harness the Silver Lining's powers.

The bees, set up and equipped, could change pieces in flight,
Directly from the inside and with no halt required.
No more dangerous stops on hostile satellites!
For the first time the crew could enjoy peace of mind.

Once they had completed all pending upgrades, and then some
The bees looked back at the fruits of their labor.
"Let's do more! Captain Tux is not the only one
Who is in need of help. Let's meet the passengers!"

The Silver Lining's passengers had long been complaining
They couldn't send messages in their own encoding.
When the bees jumped on the case, it marked the beginning
Of a whole new era for data share and messaging.

Mail was still slow to go through the ship's processors,
But the electrician bee had a great idea.
And so the swarm replaced legacy receivers,
They installed and rewired a boosted antenna.
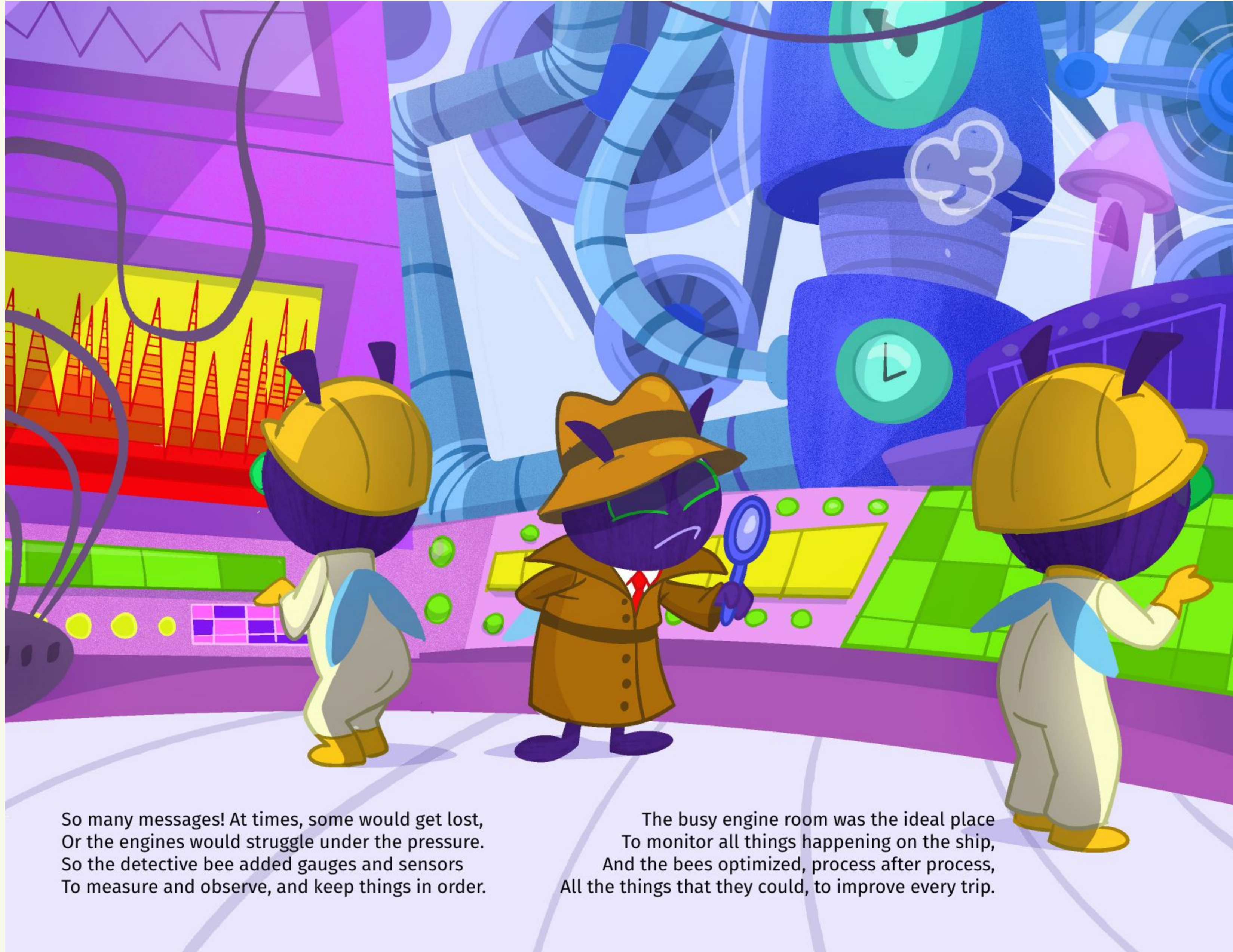
So many messages! At times, some would get lost,
Or the engines would struggle under the pressure.
So the detective bee added gauges and sensors
To measure and observe, and keep things in order.

The busy engine room was the ideal place
To monitor all things happening on the ship,
And the bees optimized, process after process,
All the things that they could, to improve every trip.
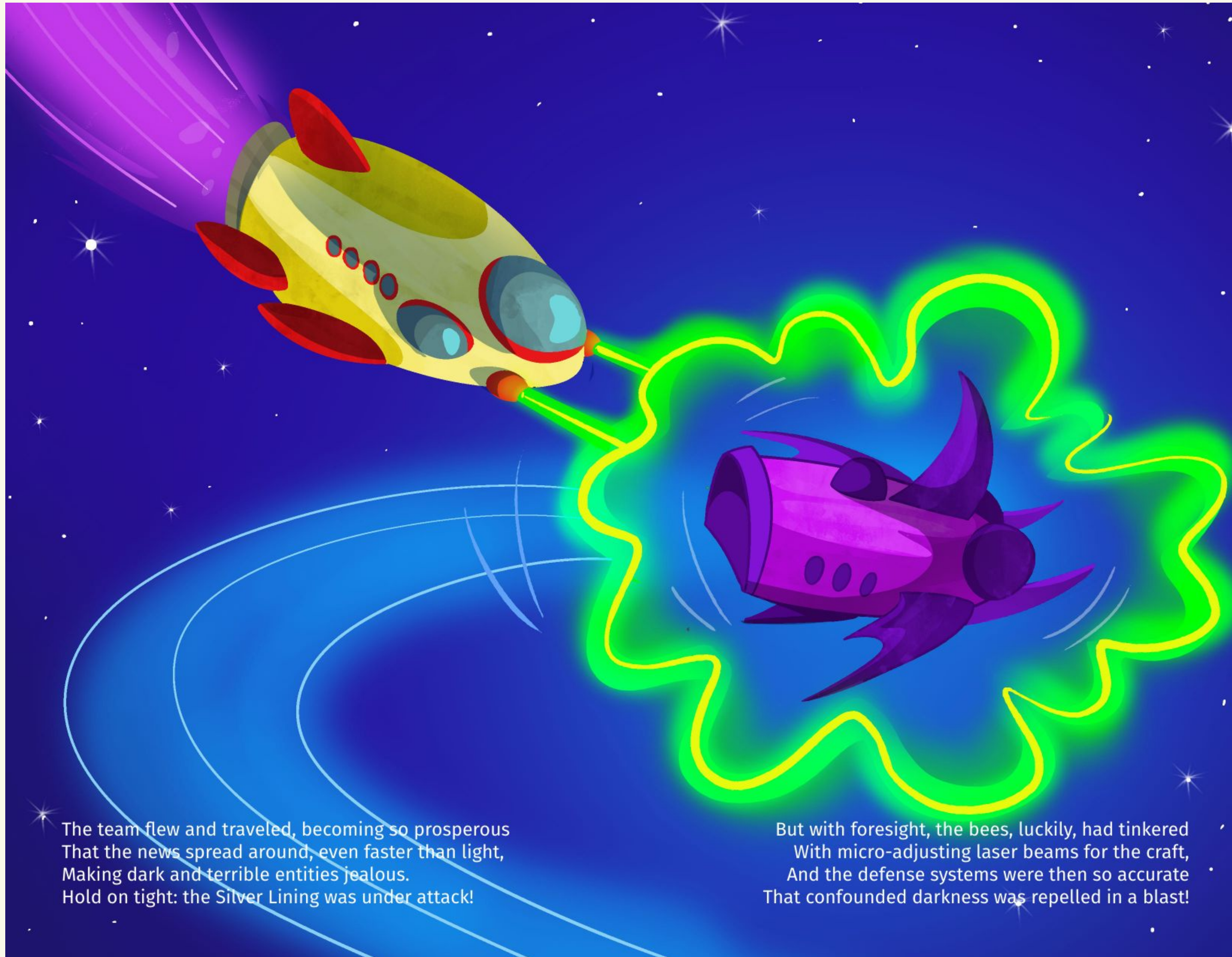
The team flew and traveled, becoming so prosperous
That the news spread around, even faster than light,
Making dark and terrible entities jealous.
Hold on tight: the Silver Lining was under attack!

But with foresight, the bees, luckily, had tinkered
With micro-adjusting laser beams for the craft,
And the defense systems were then so accurate
That confounded darkness was repelled in a blast!

Alas! During the fight a thruster was damaged.
Once at the space garage, Captain Tux found spare pieces,
But they lacked instructions, and the model had changed.
How would the bees make them fit into the engines?

And then what about the quantic guidance units?
New versions all had a completely different shape.
eBee's friends couldn't fly between the narrower bits.
Had the engine-hacking adventure met its fate?

"Not a chance" said eBee.
"Captain, I've got a plan".
And they worked all night to
build a brand new scanner,
To map all areas and paths
in the engine room,
So the bees were able to
fly again, faster!

Before the ship flew off, intrigued by the rumors,
Several creatures came to meet the spokesbee.
They wondered if the bees would like to join efforts
And collaborate on craft, speeders, and ferries.

eBee was delighted and agreed that the hive
Would split, some bees going to new ships and new teams.
And the word spread further of transports that would thrive
With bees under the hood, making them go full steam.

As fame grew and bees spread, they felt the desire
To keep contact and share news, knowledge, tips and tricks,
To better tell around how their skills were for hire.
And the united bees formed the Hive Alliance.

Under this new banner, bees now help innovate
Teams on various vessels, keeping them fast and sound.
Far away, beyond skies, asteroids, and dust,
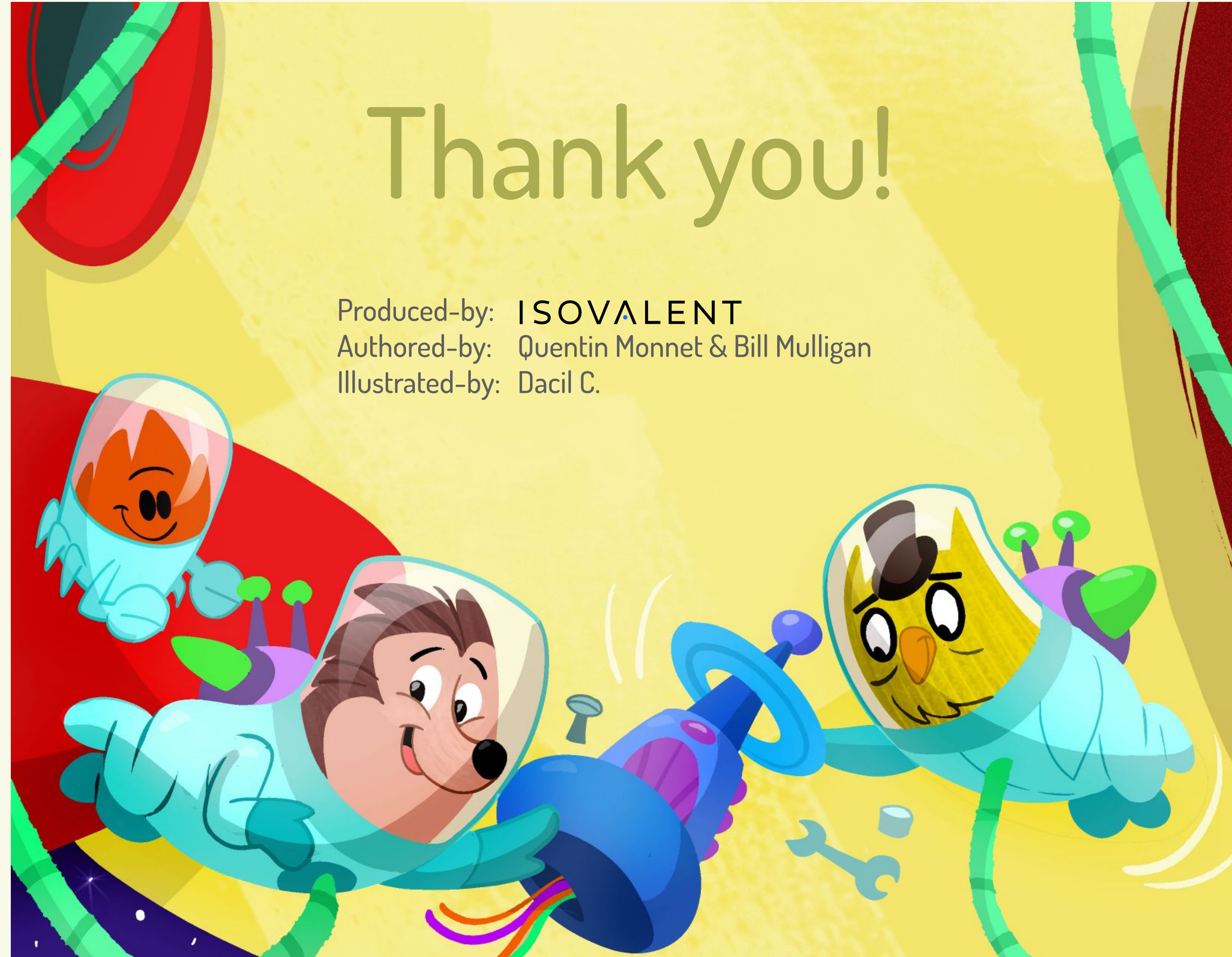When he thinks of the bees, Captain Tux is so proud!

After years of proven production experience, eBPF has been adopted for Windows and other privileged execution contexts.

The eBPF Foundation now brings together a cross-platform community of eBPF-related projects. Part of the Foundation, the BPF Steering Committee is responsible for the technical direction and overall vision of eBPF and as of 2023, there is work in progress with the IETF (Internet Engineering Task Force) for standardizing eBPF.