{Ba,E}dge Computing

Adding Compute to Conference Badges

SCALE

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and former Site Reliability Engineer

@sofixa

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Sr. Developer Advocate at HashiCorp
for Infrastructure and Orchestration

@ksatirli

edge com·put·ing

noun

edge com·put·ing

noun

computing that takes place at or near the *physical location* of the producer or consumer of data.

edge com·put·ing

noun

computing that takes place at or near the *physical location* of the producer or consumer of data.

Similar: point of presence mobile datacenter

badge com·put·ing

noun

computing that takes place on your conference or event badge, using a SBC and e-paper screen.

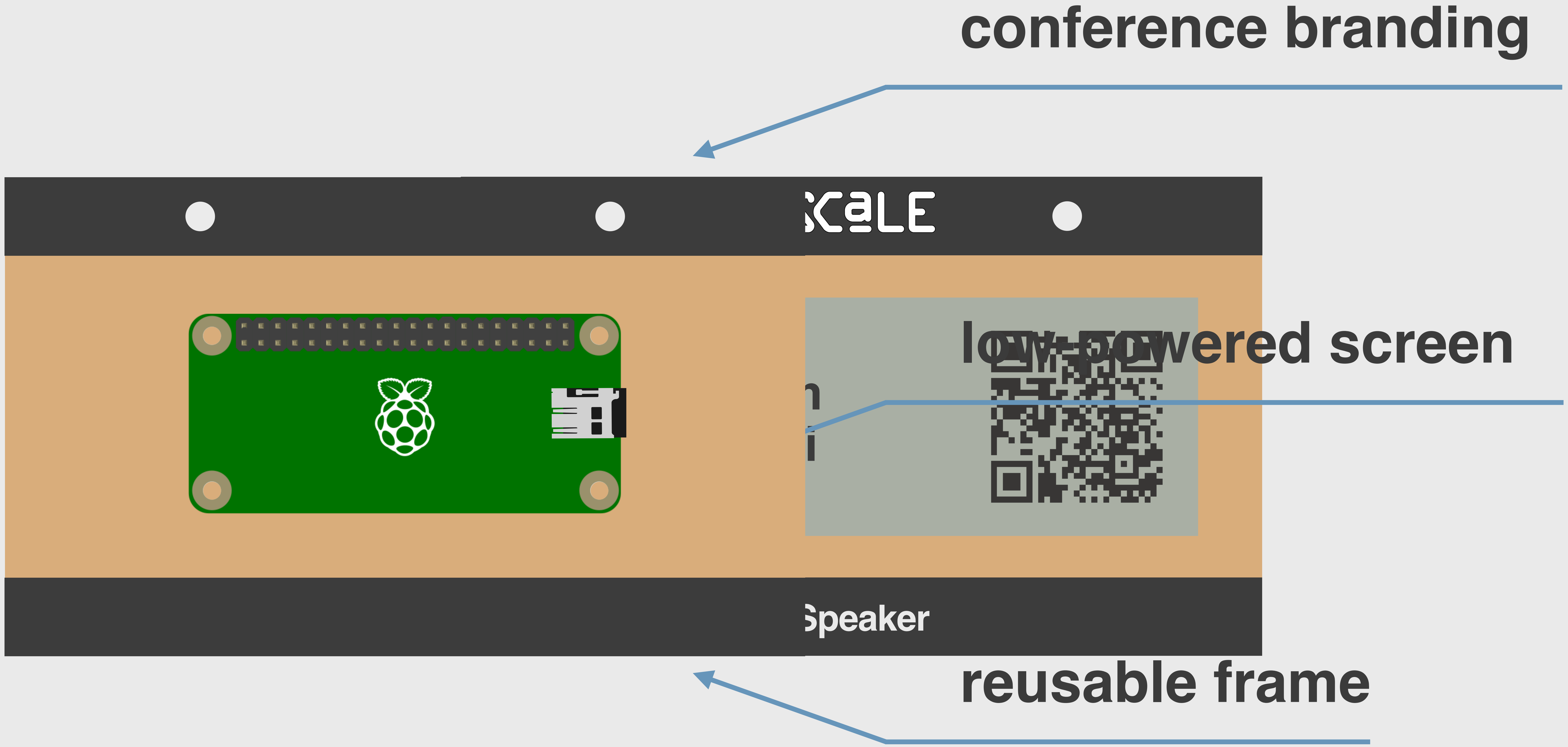
1

The Idea

SCALE

Kerim
Satirli

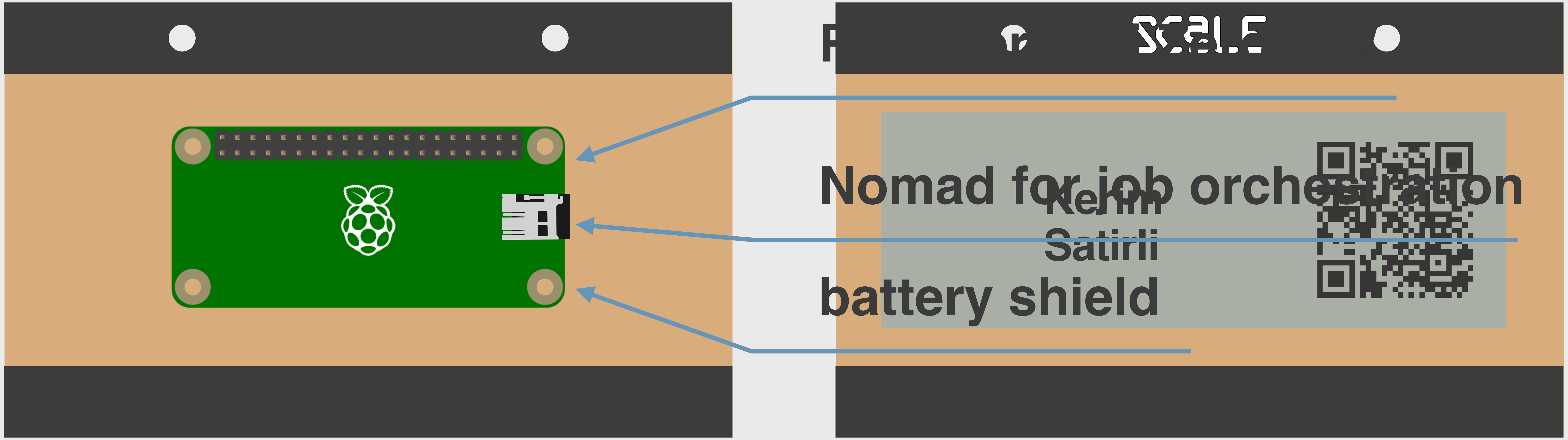
Speaker



conference branding

low-powered screen

reusable frame



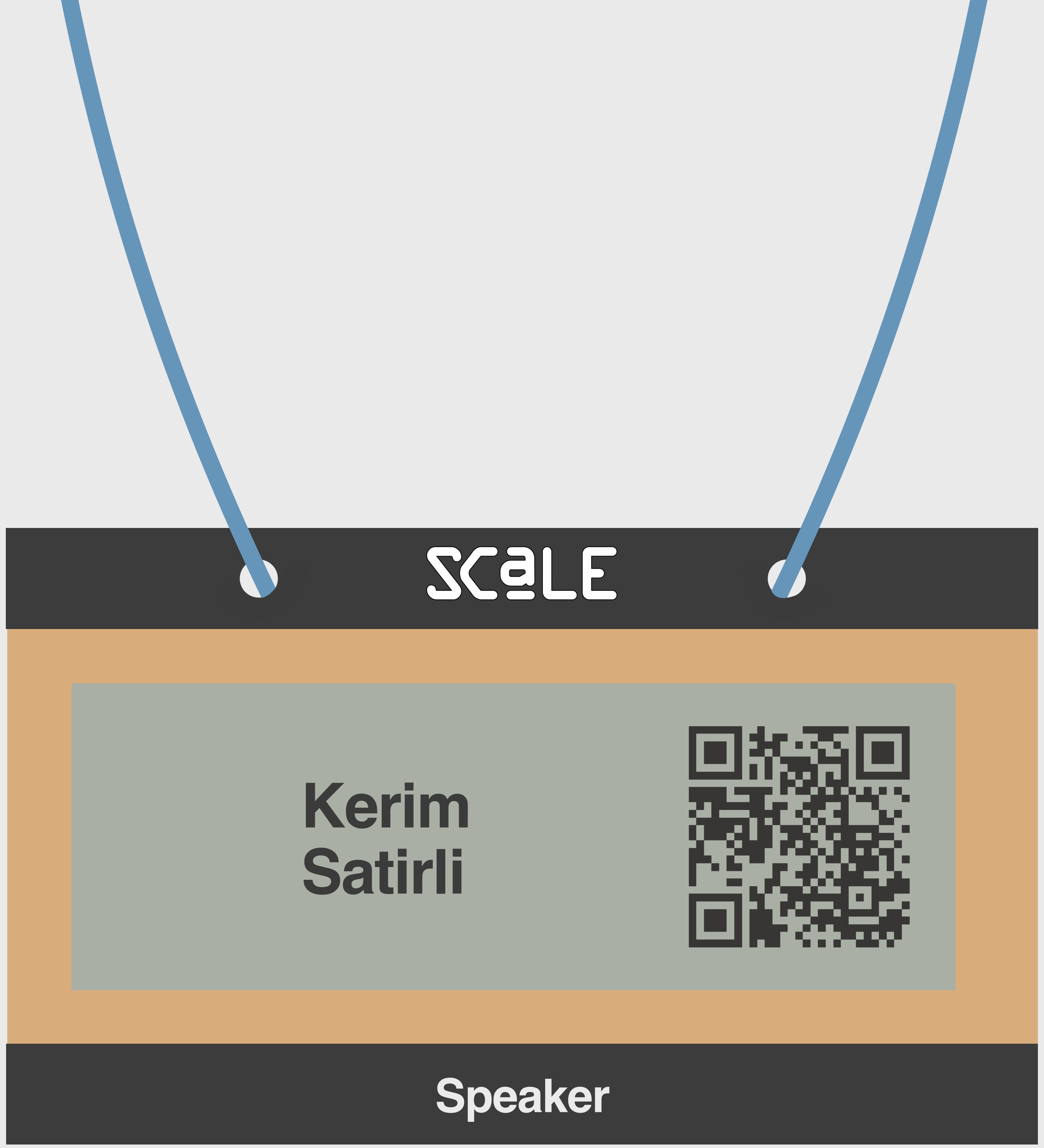
Raspberry Pi Zero W

Nomad for job orchestration

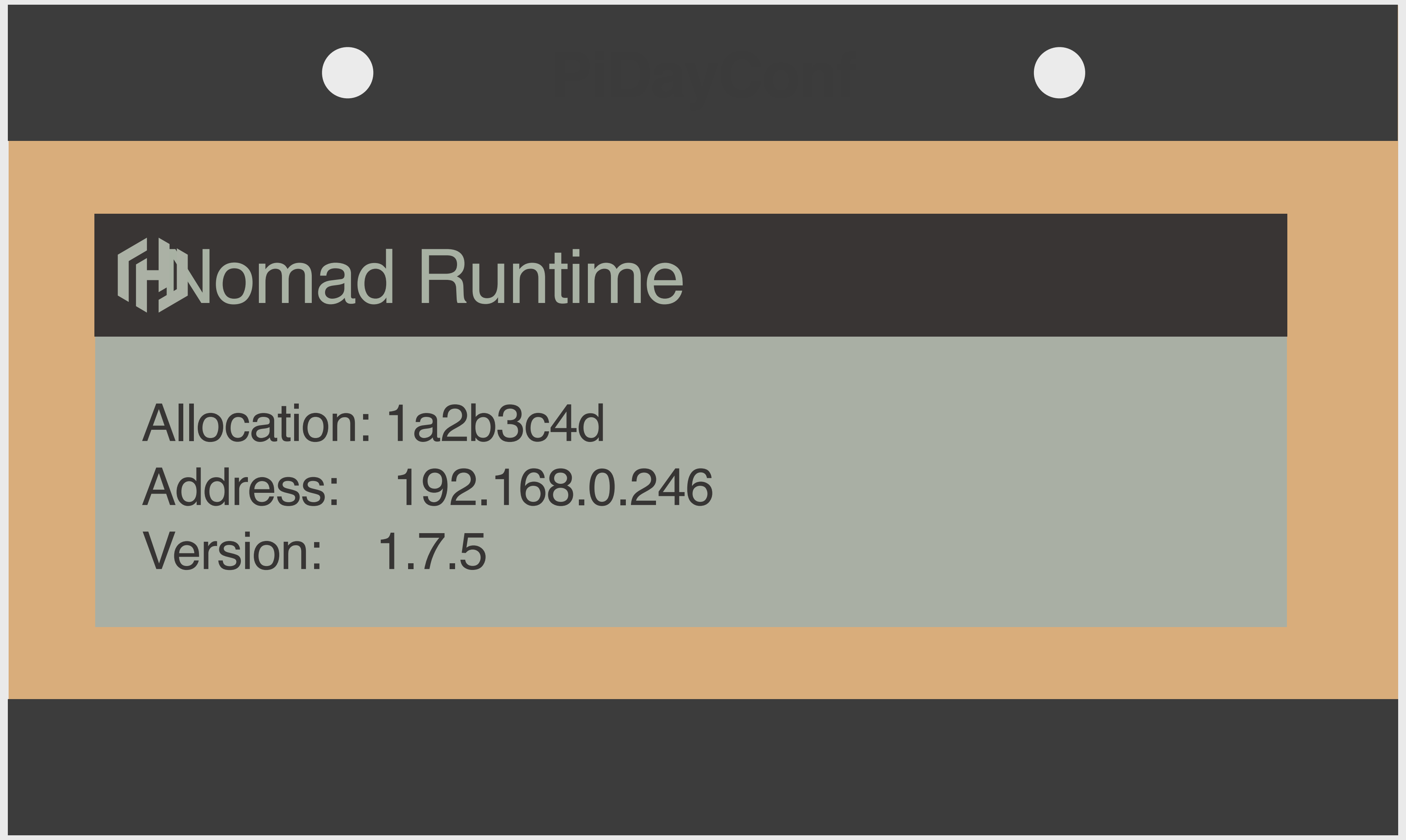
battery shield

back

front



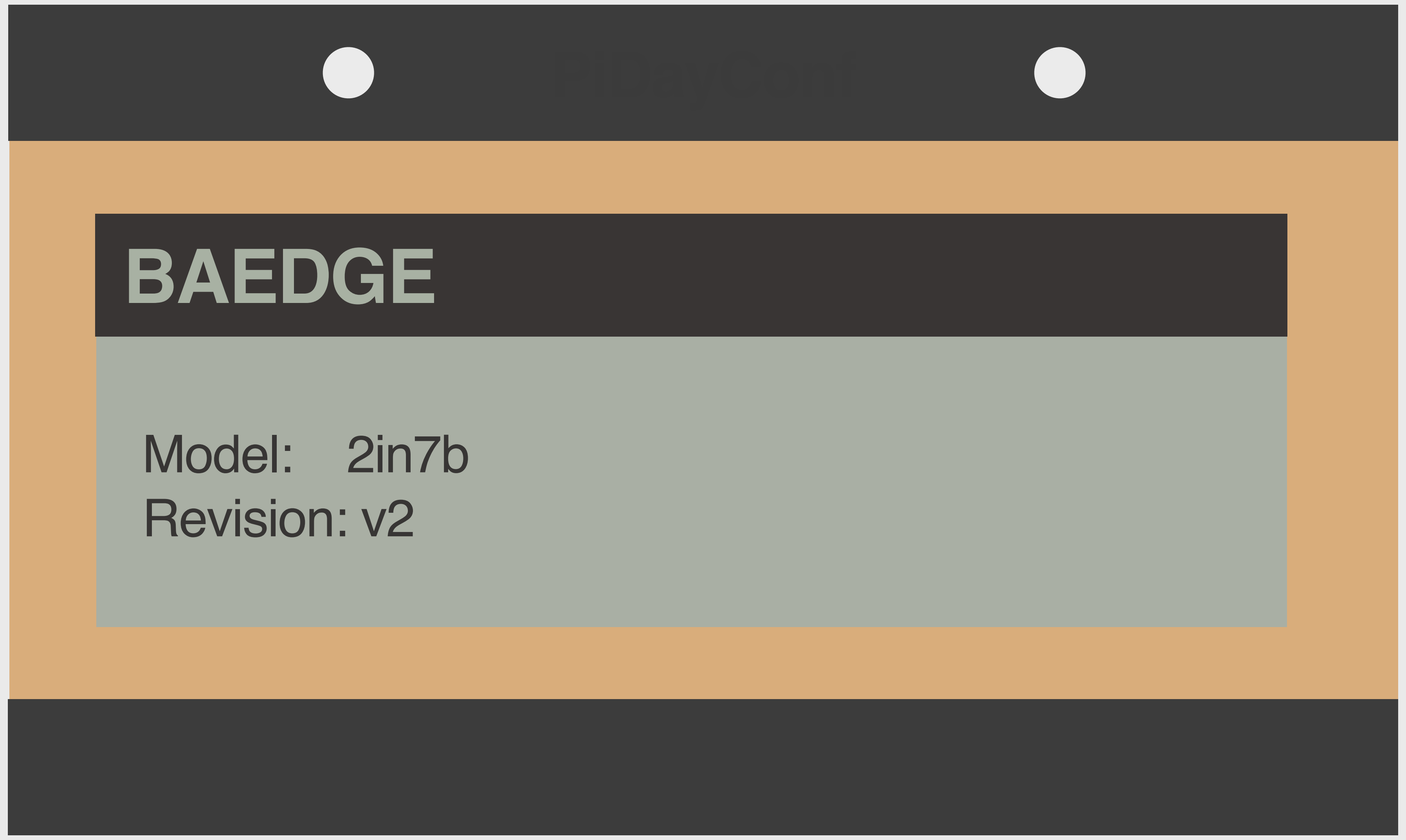
"Wearer" screen



Nomad Runtime

Allocation: 1a2b3c4d
Address: 192.168.0.246
Version: 1.7.5

"Nomad" screen



BAEDGE

Model: 2in7b
Revision: v2

"Baedge" screen

2

The Problem(s)

2.1

Targeting

Problem:

not all workers may be eligible for work

Targeting Patterns

Software Support

- operating system (type, patch)
- system-specific fingerprinting
- driver and port availability

Hardware Support

- CPU architecture and speed
- resources (disk / memory)
- security rating (ports sealed?)

Targeting Patterns, cont'd.

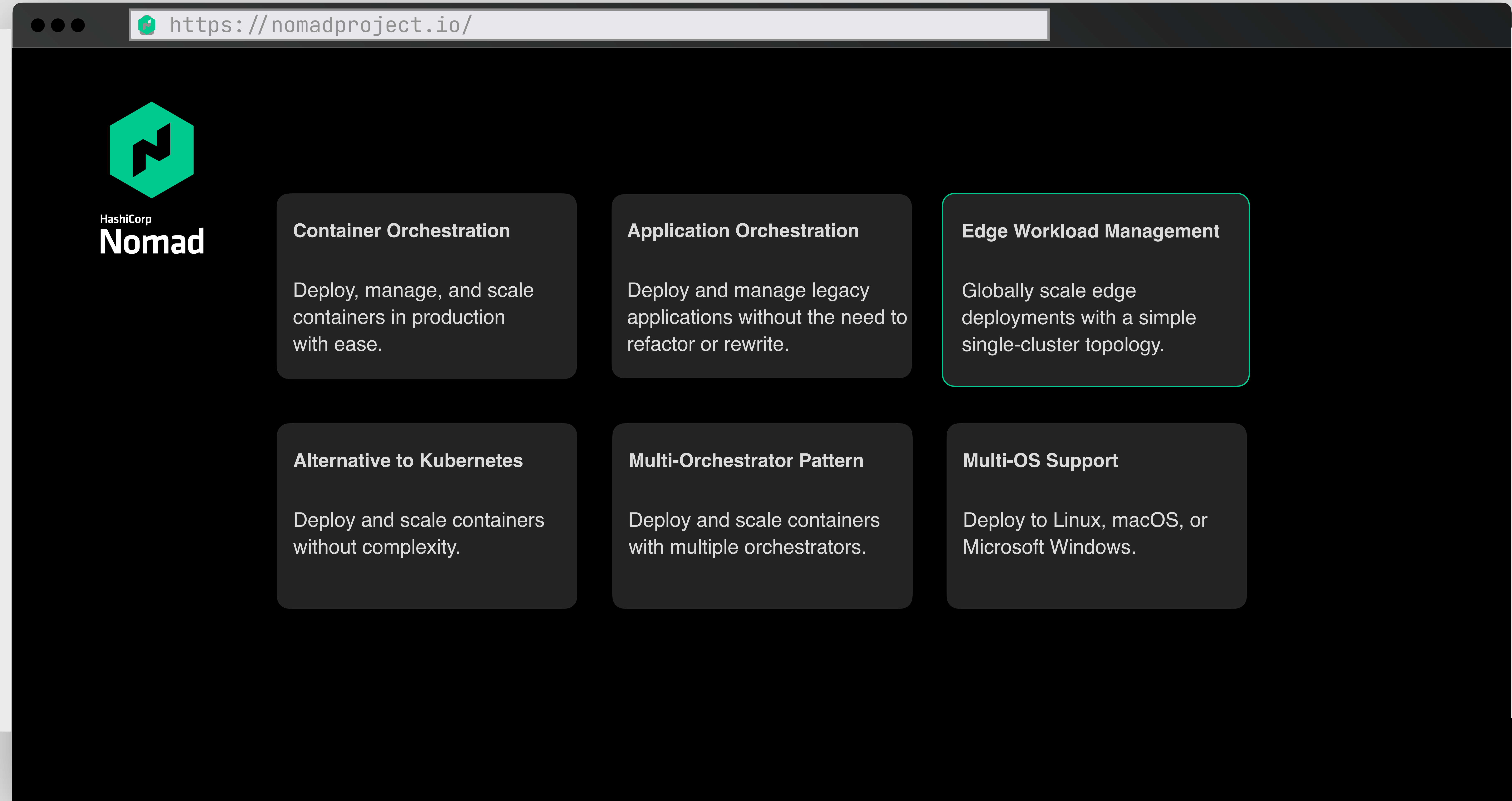
Uplinks

- wired or wireless (or both)
- fall-back uplinks / networks
- additional uplink methods

Power

- hardwired or battery
- battery health (cycles, maint.)
- remaining vs. requ'd runtime

HashiCorp Nomad



https://nomadproject.io/

Container Orchestration

Deploy, manage, and scale containers in production with ease.

Application Orchestration

Deploy and manage legacy applications without the need to refactor or rewrite.

Edge Workload Management

Globally scale edge deployments with a simple single-cluster topology.

Alternative to Kubernetes

Deploy and scale containers without complexity.

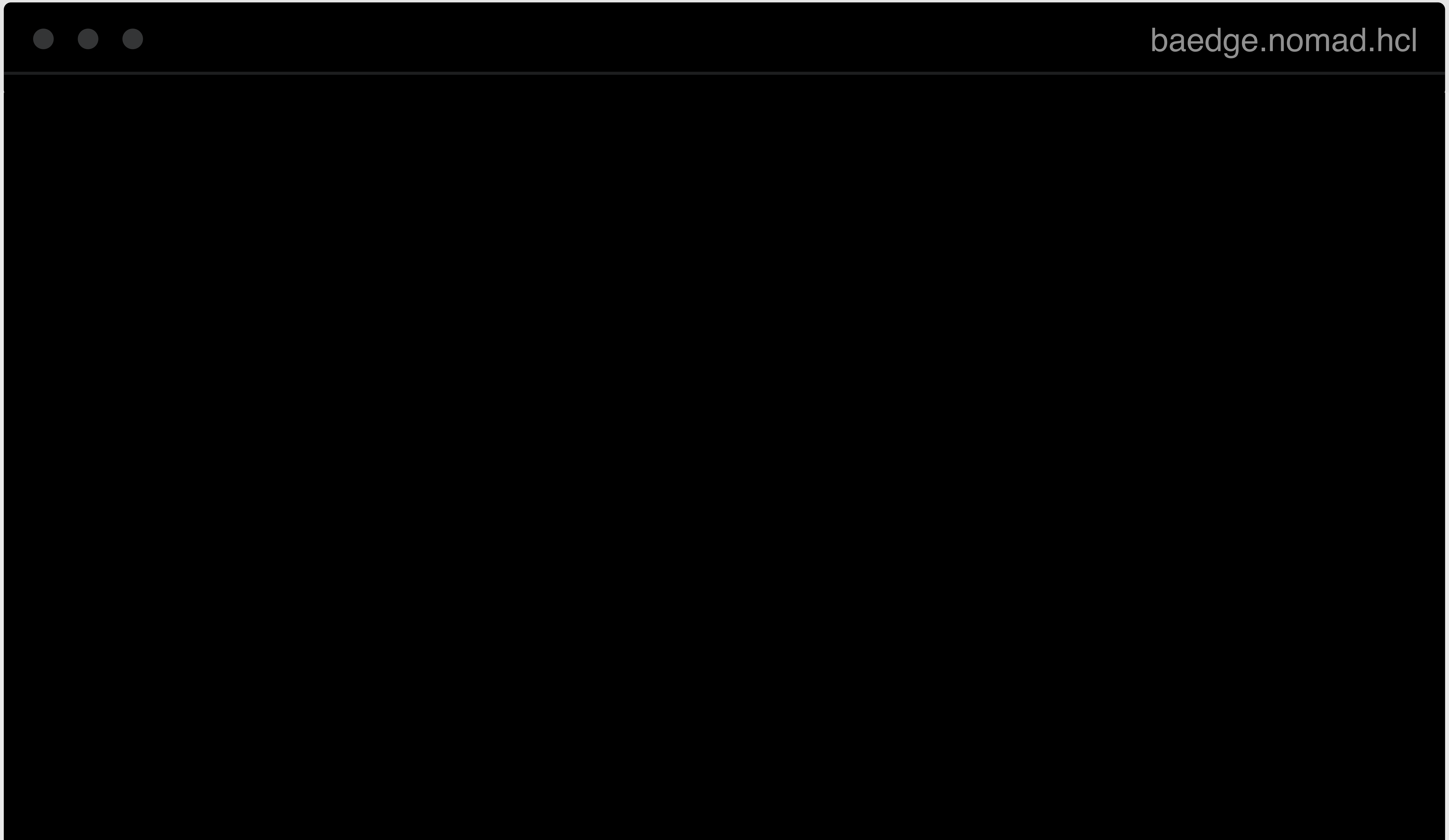
Multi-Orchestrator Pattern

Deploy and scale containers with multiple orchestrators.

Multi-OS Support

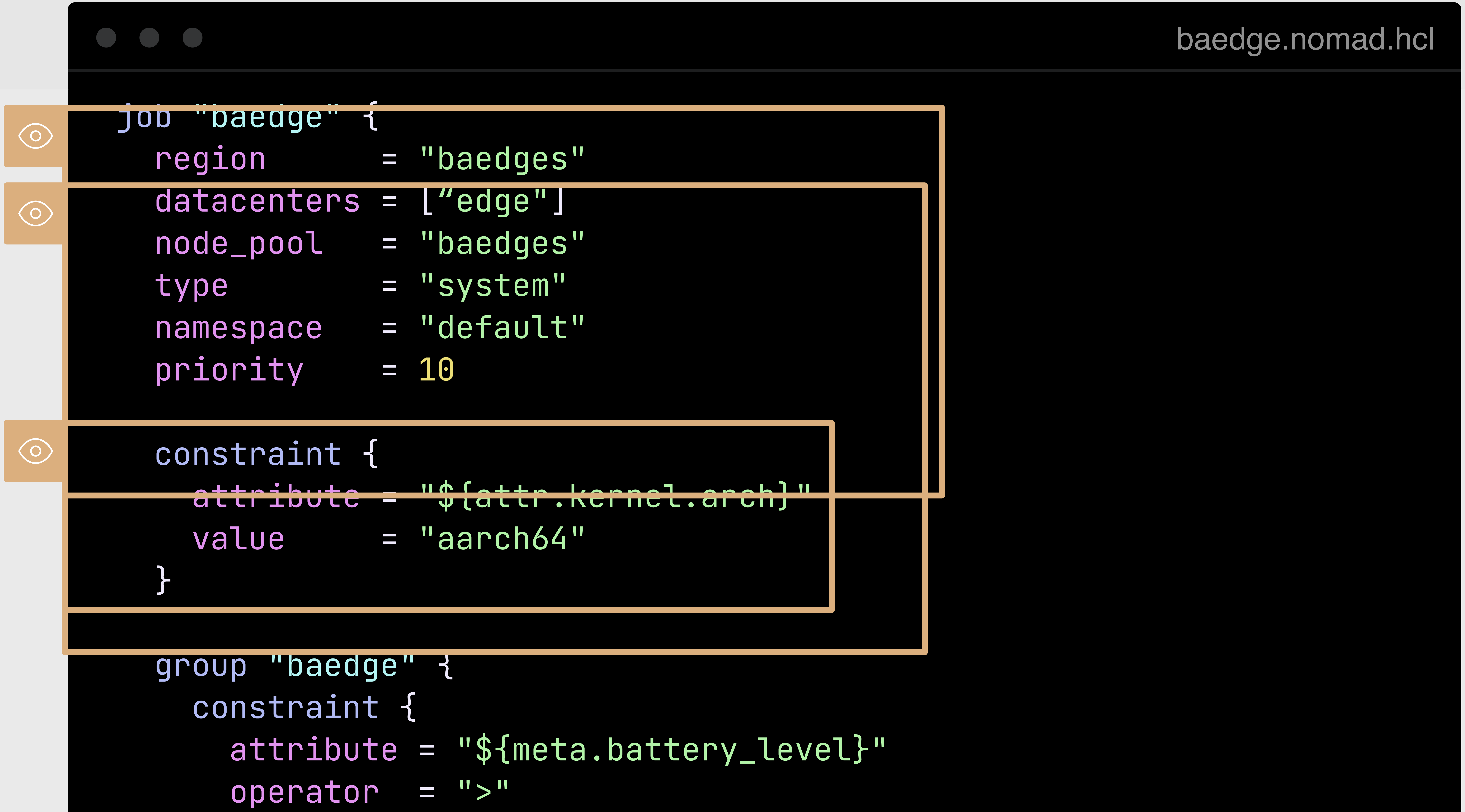
Deploy to Linux, macOS, or Microsoft Windows.

Constraints



baedge.nomad.hcl

Constraints



```
job "baedge" {
  region      = "baedges"
  datacenters = [“edge"]
  node_pool   = "baedges"
  type        = "system"
  namespace   = "default"
  priority    = 10

  constraint {
    attribute = "${attr.kernel.arch}"
    value     = "aarch64"
  }

  group "baedge" {
    constraint {
      attribute = "${meta.battery_level}"
      operator  = ">"
```

⊕ NCR18650B ⊖
Li-ion MD12210
WARNING: BATTERY MAY EXPLODE OR FIRE IF MISTREATED.
DO NOT DISASSEMBLE OR DISPOSE OF IN FIRE. DO NOT
CHARGE EXCEPT SPECIFIED CHARGING CONDITION. DO NOT
HEAT ABOVE 212°F OR SHORT CIRCUIT.
DO NOT CRUSH OR MODIFY.
MADE IN JAPAN

runtime (h) =

$$\text{runtime (h)} = \frac{\text{battery capacity (mAh)}}{\text{power consumption (mW)}}$$

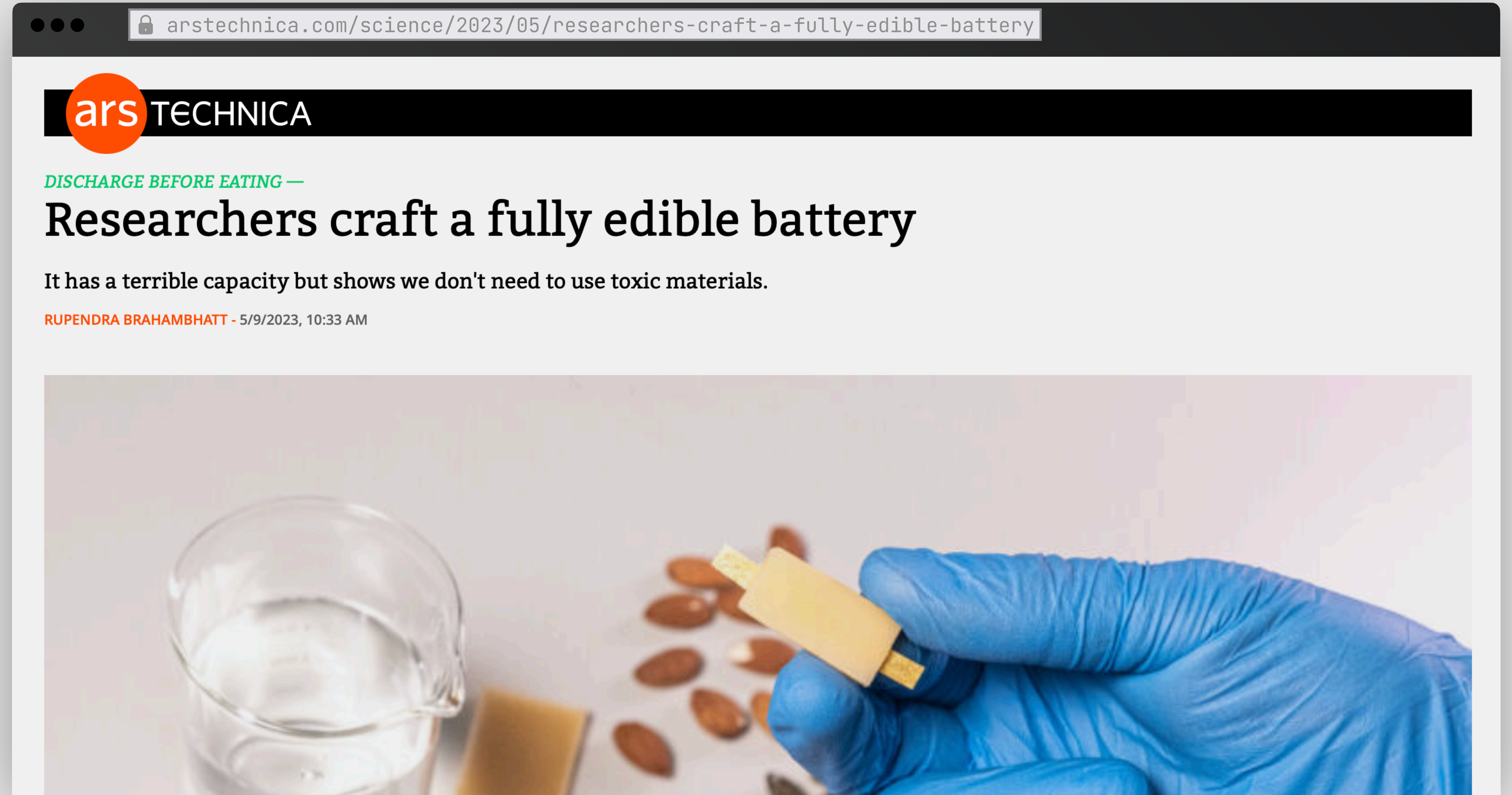
3450 mAh

700 mW

(under max. load)

4.92 h

Power-up?



arstechnica.com/science/2023/05/researchers-craft-a-fully-edible-battery

DISCHARGE BEFORE EATING —

Researchers craft a fully edible battery

It has a terrible capacity but shows we don't need to use toxic materials.

RUPENDRA BRAHAMBHATT - 5/9/2023, 10:33 AM

2.2

Connectivity

Problem:

not all workers may have healthy backhauls

Connectivity Patterns

local-first

- limit need for active uplinks
- gracefully degrade service
- architect for local operations

reconnecting

- back-off and retry strategy
- support for network roaming
- alternate backhauls)

Connectivity Patterns, cont'd.

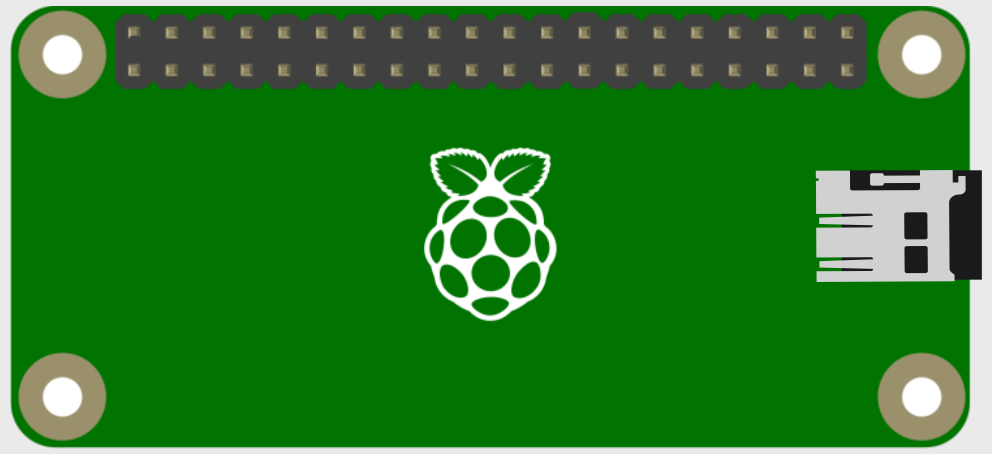
data / system integrity

- data deduplication strategy
- forced updates
- manage device replacement

coverage

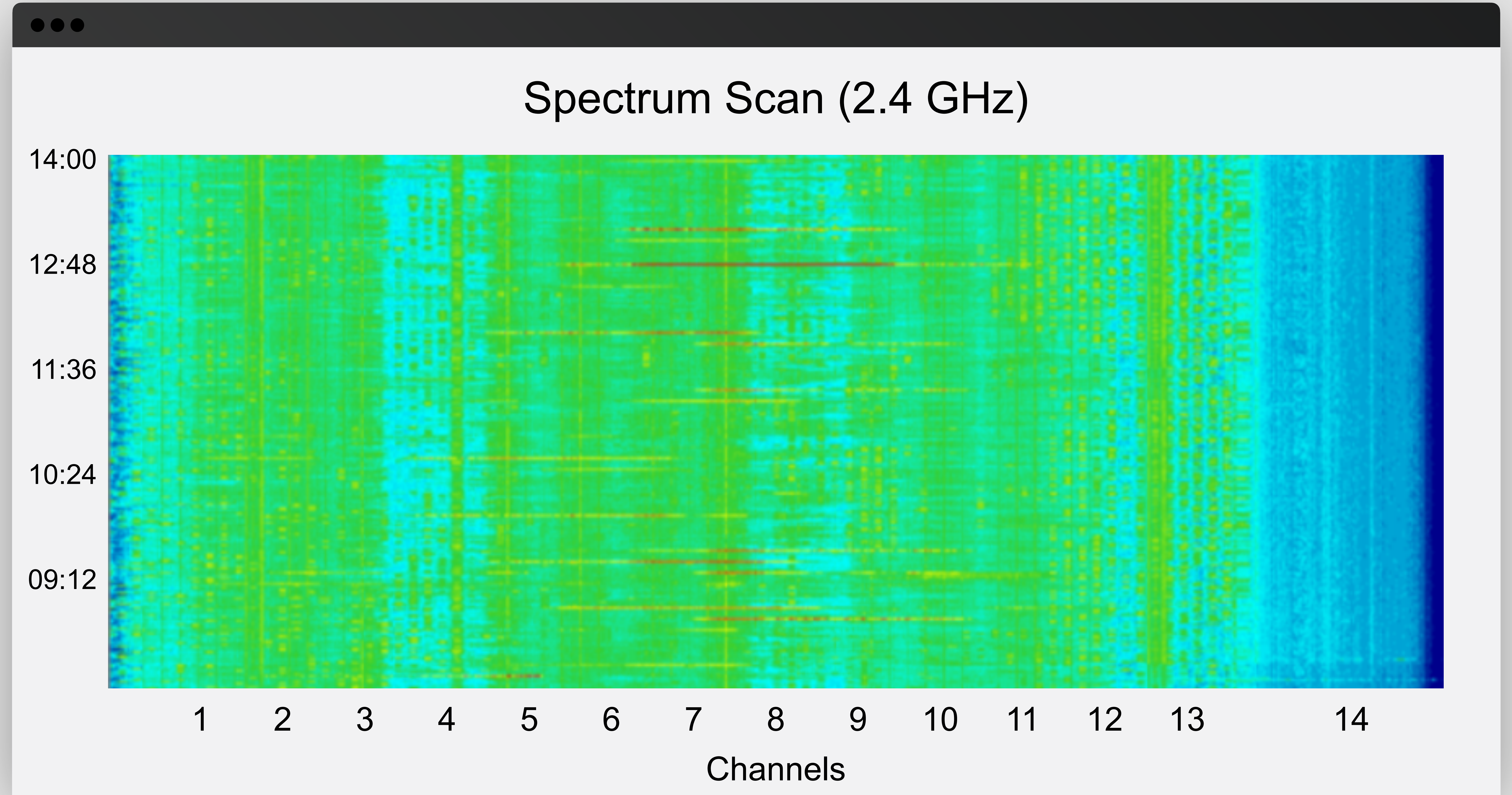
- continuously evaluate service
- map outages (time, location)
- expand coverage of network

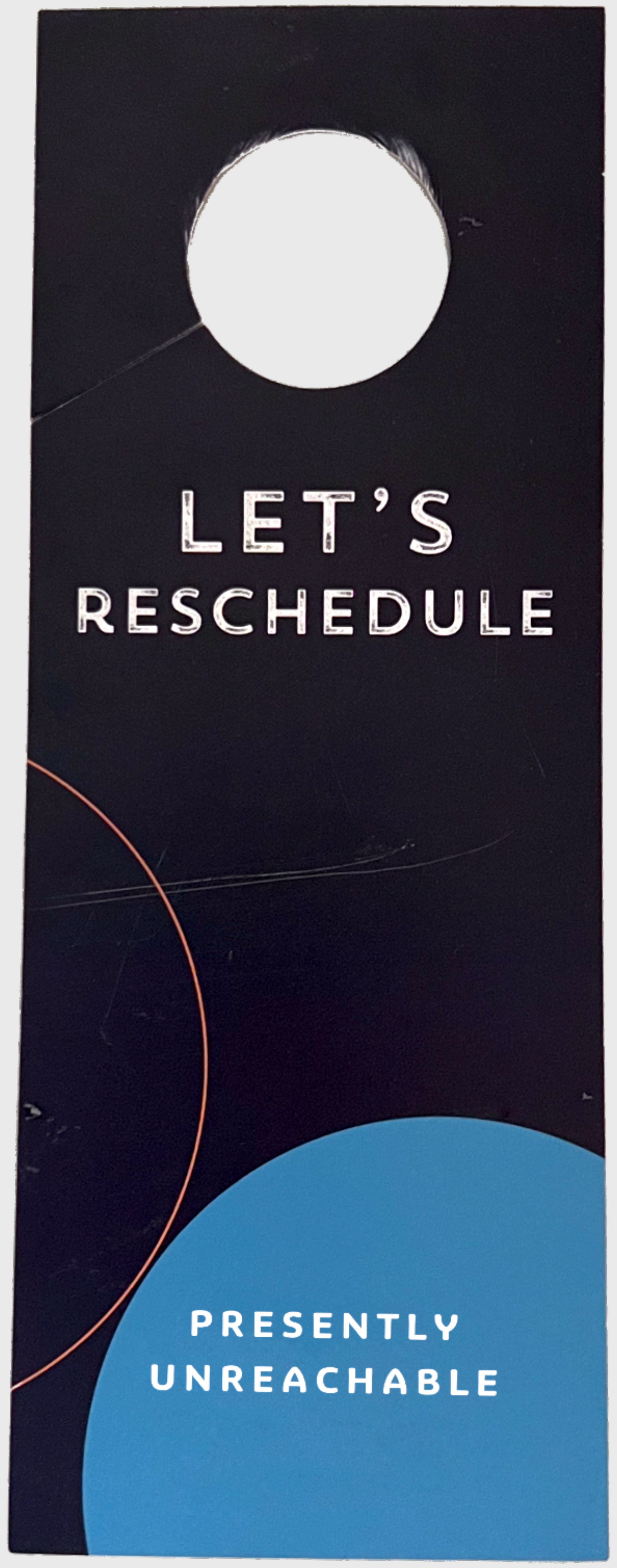
reception okay'ish

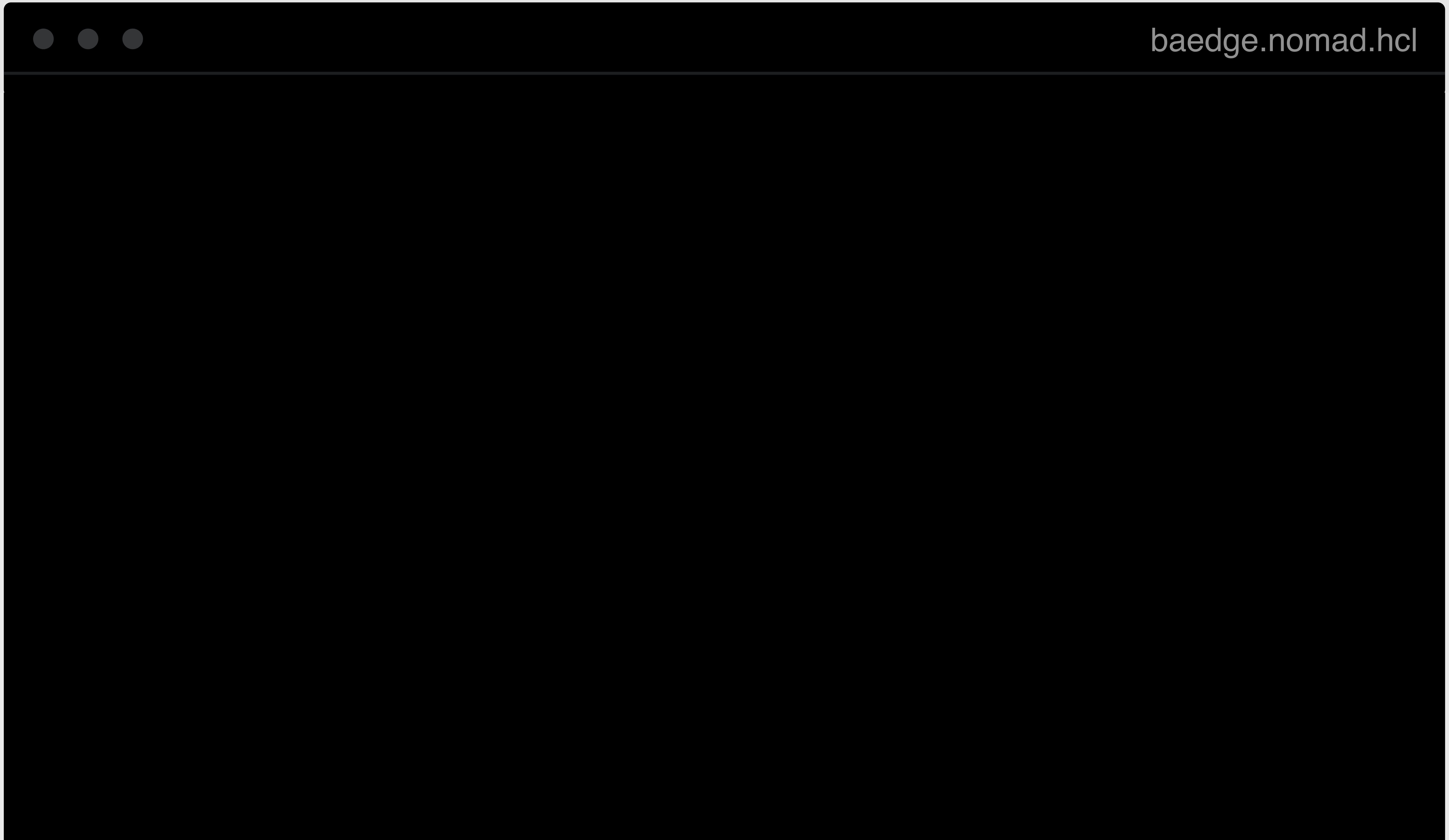


frequently disconnects

Connectivity

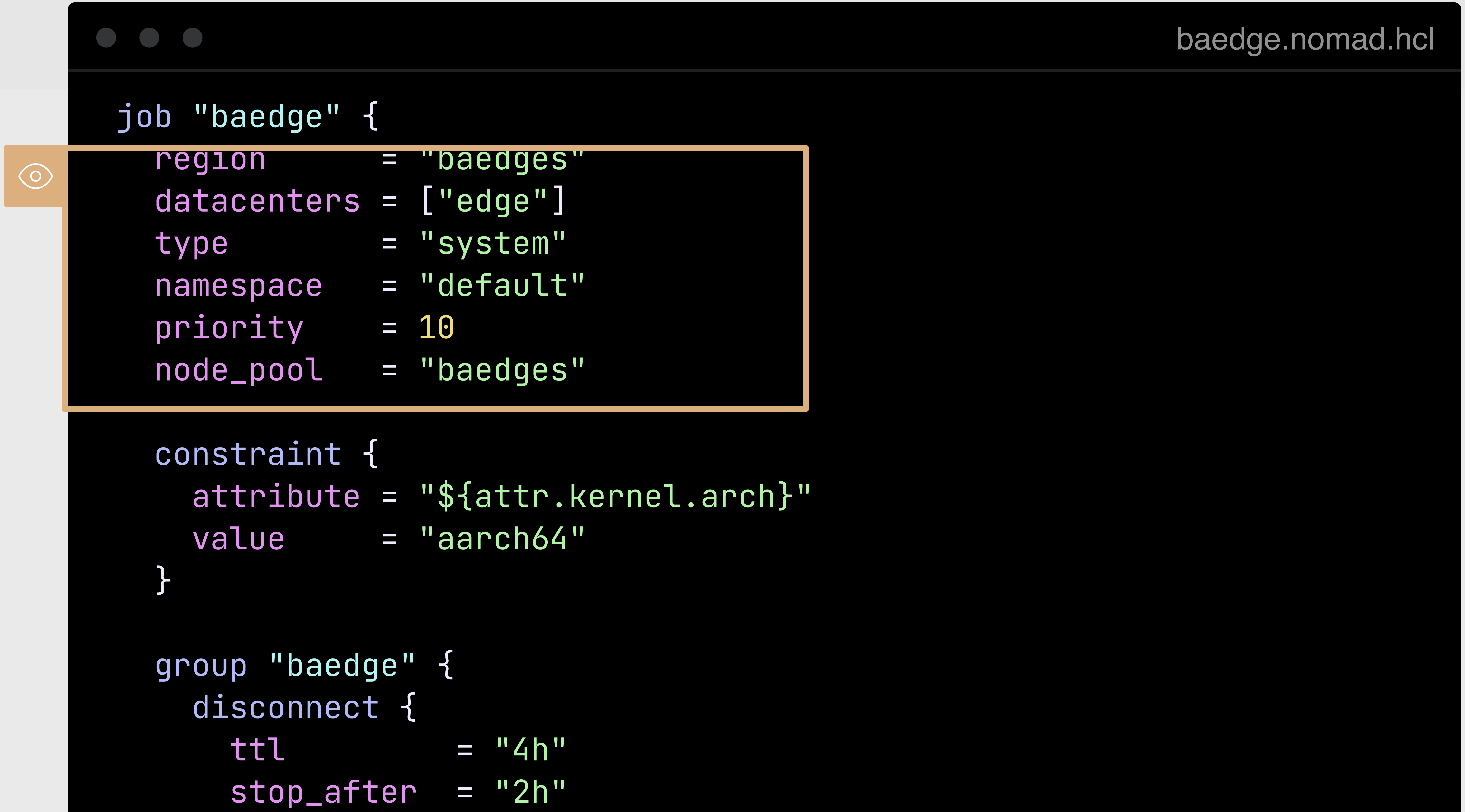



LET'S
RESCHEDULE
PRESENTLY
UNREACHABLE



baedge.nomad.hcl

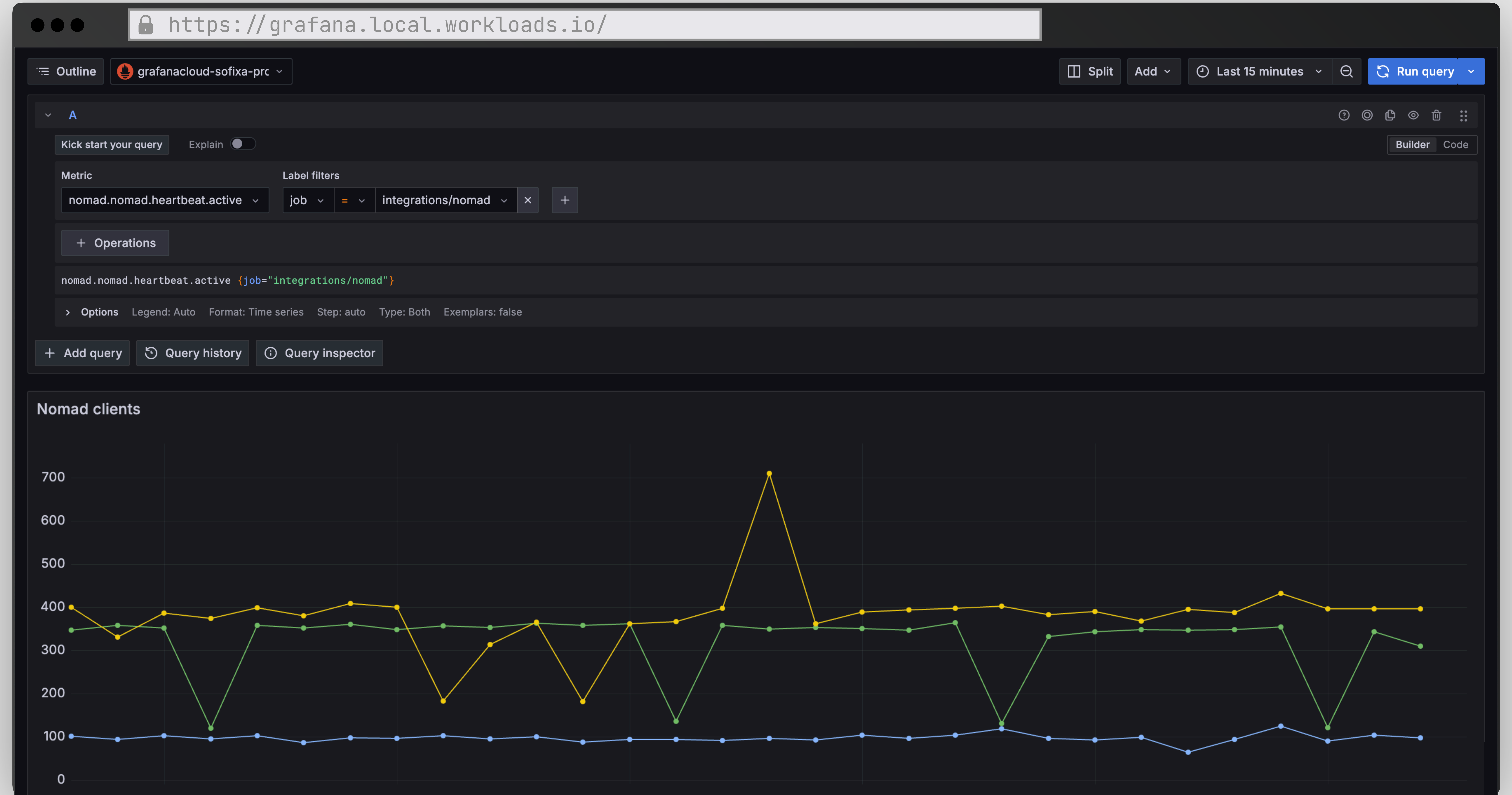
Disconnect



baedge.nomad.hcl

```
job "baedge" {
  region      = "baedges"
  datacenters = ["edge"]
  type        = "system"
  namespace   = "default"
  priority    = 10
  node_pool   = "baedges"

  constraint {
    attribute = "${attr.kernel.arch}"
    value     = "aarch64"
  }

  group "baedge" {
    disconnect {
      ttl          = "4h"
      stop_after   = "2h"
```

Observability



https://grafana.local.workloads.io/

Metric: nomad.nomad.heartbeat.active

Label filters: job = integrations/nomad

```
nomad.nomad.heartbeat.active {job="integrations/nomad"}
```

Options Legend: Auto Format: Time series Step: auto Type: Both Exemplars: false

Nomad clients

2.3

Applications

Problem:

not all workloads may

be built like, well, 🏆

be built 'agreeably'

Application Patterns

flexible

- hot-reload config
- functional tiers

tolerant

- gracefully degrade
- easy deployments

Application Patterns, cont'd.

observable

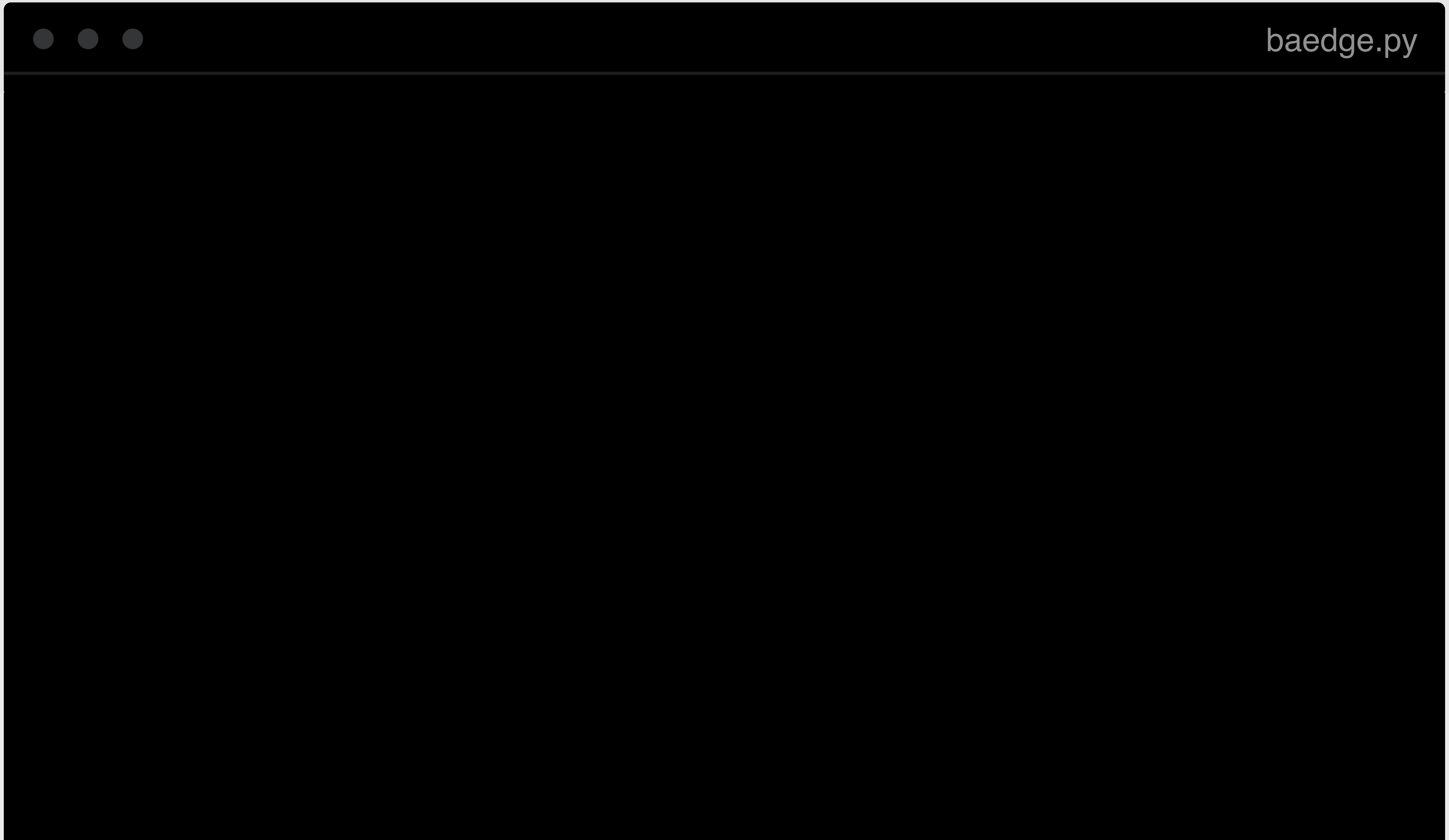
- predict maintenance
- utilize digital twins mindfully

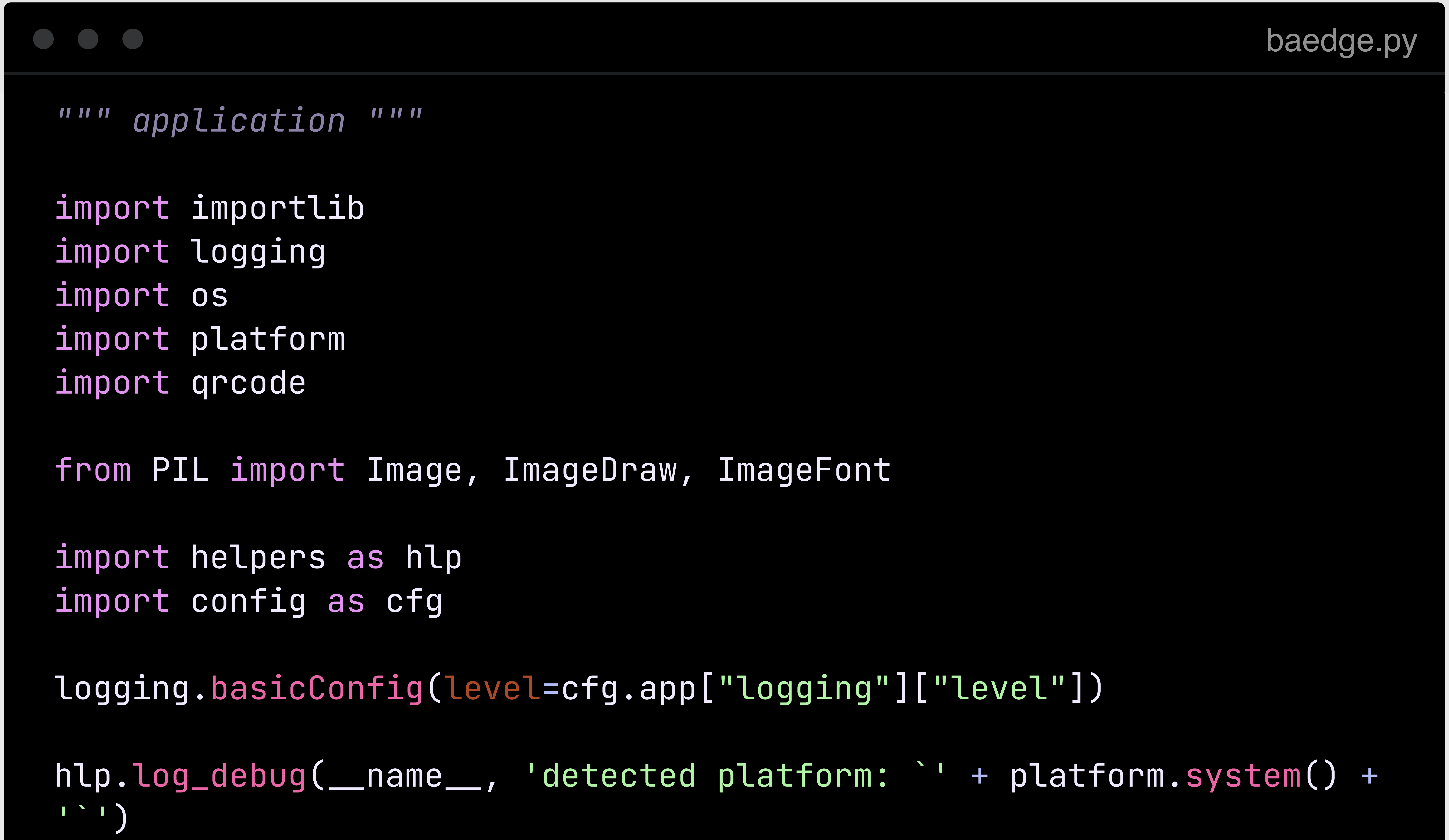
replaceable

- data inheritance strategy
- modular SW, HW architecture

03

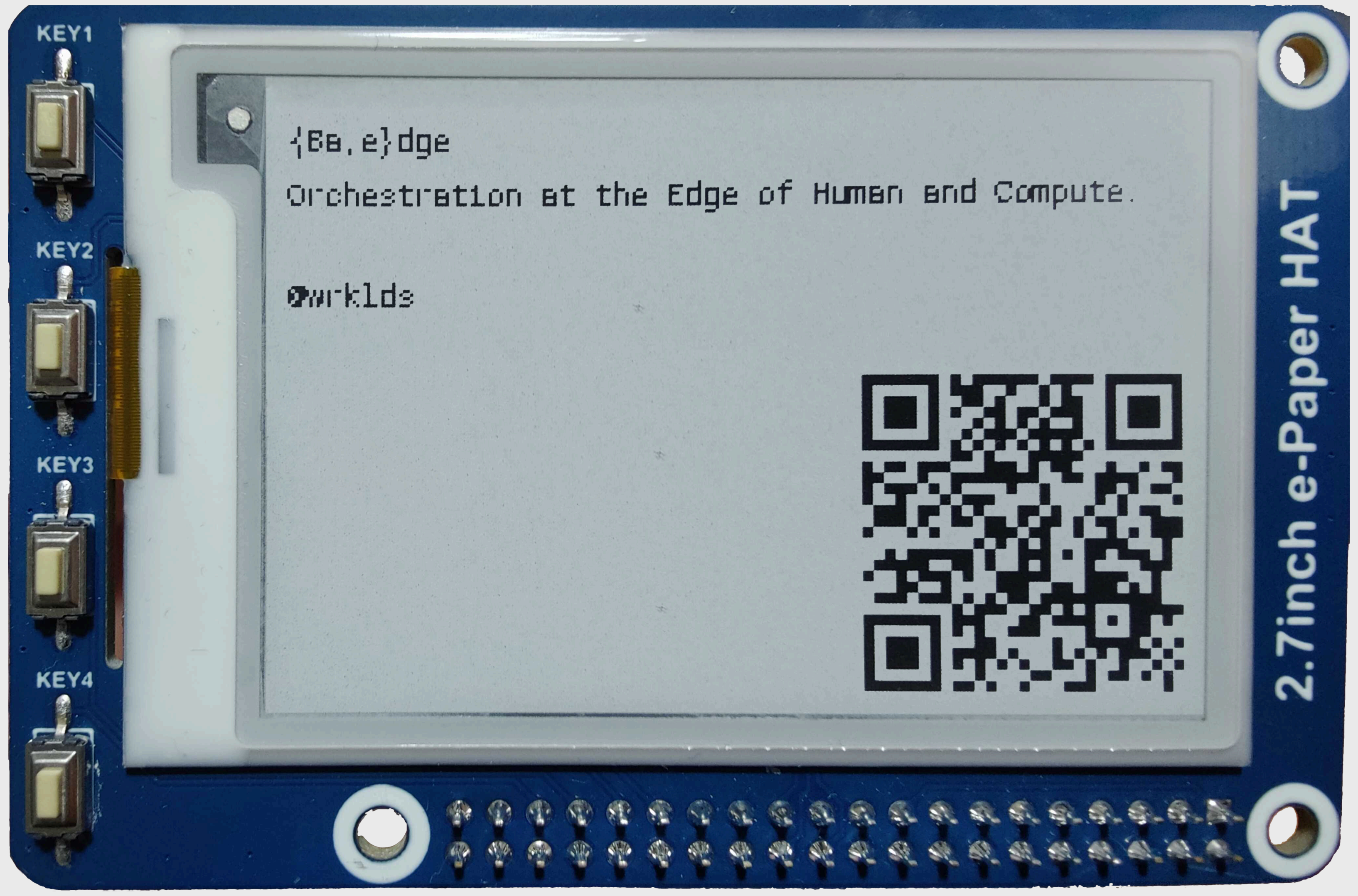
Prototyping


baedge.py



```python
""" application """

import importlib
import logging
import os
import platform
import qrcode

from PIL import Image, ImageDraw, ImageFont

import helpers as hlp
import config as cfg

logging.basicConfig(level=cfg.app["logging"]["level"])

hlp.log_debug(__name__, 'detected platform: `' + platform.system() + '`')
```

"SCaLE" screen

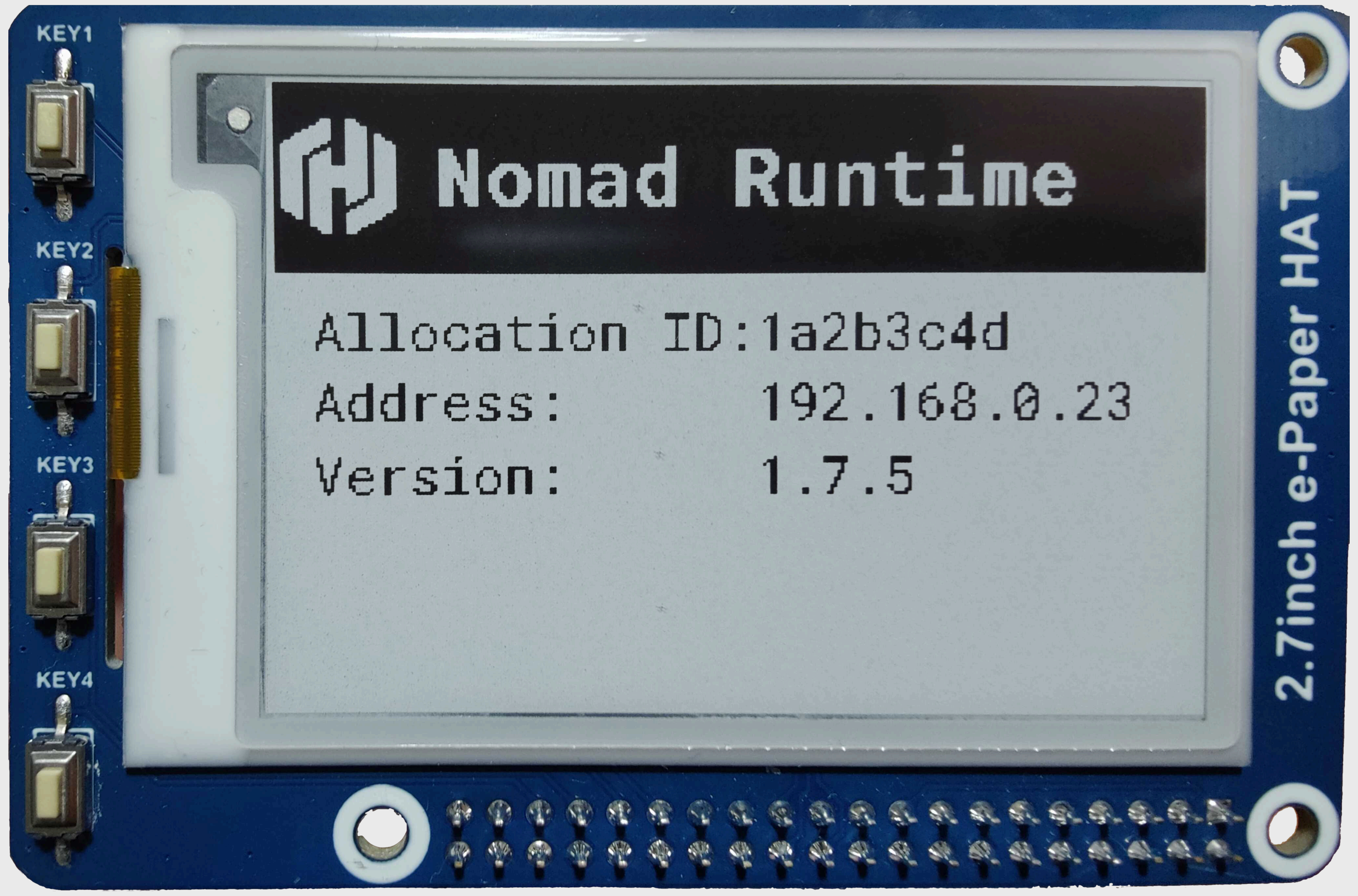


{Ba,e}dge

Orchestration at the Edge of Human and Compute.

@wrklds

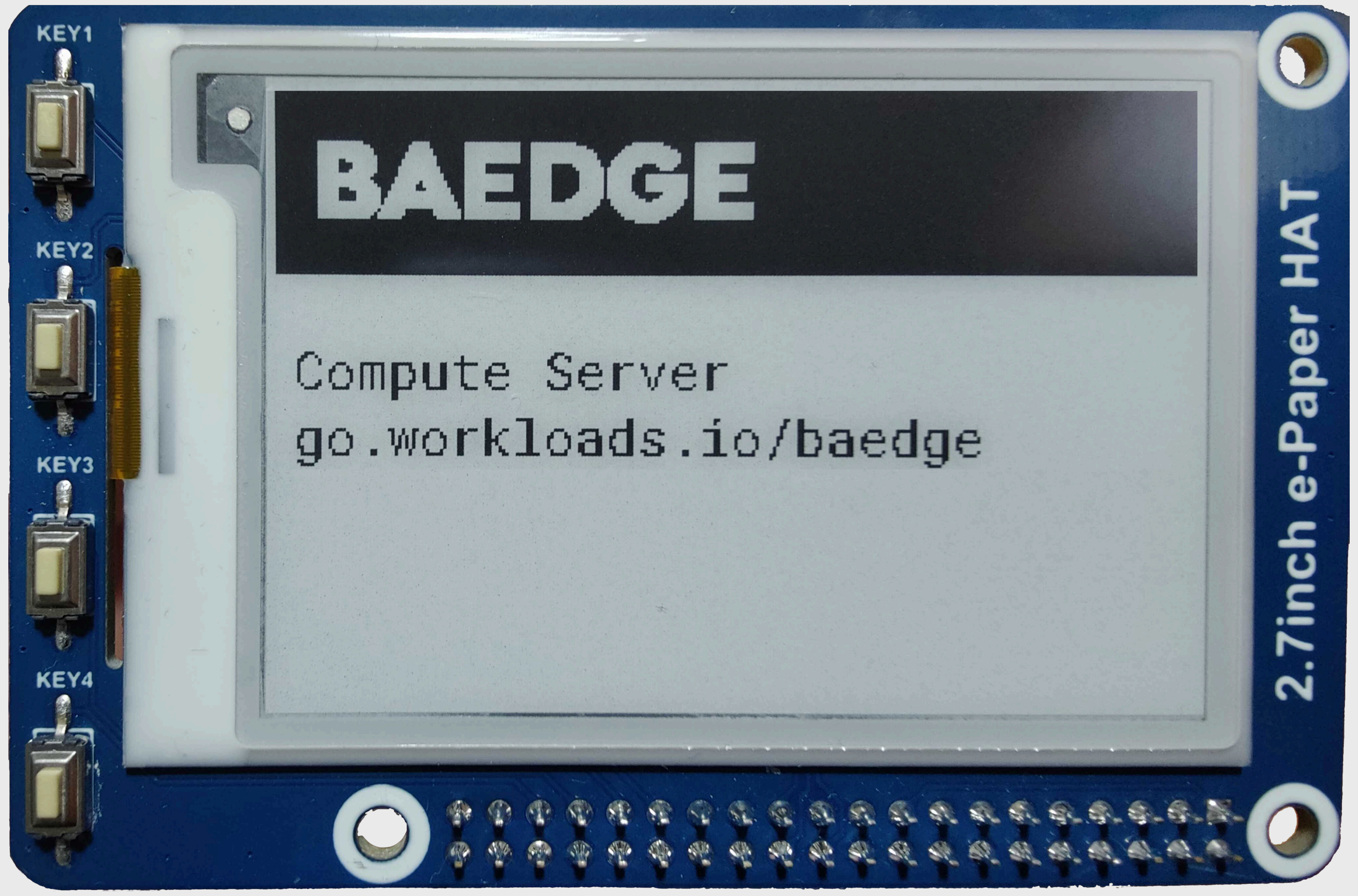
"Wearer" screen



Nomad Runtime

```
Allocation ID:1a2b3c4d
Address:      192.168.0.23
Version:      1.7.5
```

"Nomad" screen



BAEDGE

```
Compute Server
go.workloads.io/baedge
```

"Baedge" screen

Camera
Kerim
Satirli
HashiCorp
{Ba,e}dge.
Orchestration at the Edge of Human and Compute.
@arklds
LEMP

This talk wasn't about conference badges.

This talk was about fault tolerance on the edge.

Demo Code

github.com/workloads/baedge

Thank you

speakerdeck.com/ksatirli

Thank you

speakerdeck.com/ksatirli

SCaLE