

Implementing DevOps in IoT



Achieving streamlined firmware delivery and increased operational efficiency

Agenda

- My journey with DevOps
- The benefits of incorporating DevOps in IoT
- Demo: Using GitHub Actions for CI/CD in IoT
- Expanding on the demo for provisioning at scale
- Final thoughts & customer story



Dylan Swartz

*Product Manager by day
ChatGPT assisted programmer
by night*

- Product Manager at Golioth
 - 10+ years software dev
 - Previously experience:
 - Particle.io (IoT)
 - Auth0 / Okta (Developer APIs)
 - Mason (Custom Android Devices)
 - Cengage Learning (Cloud Infra)
-

DevOps at Cengage

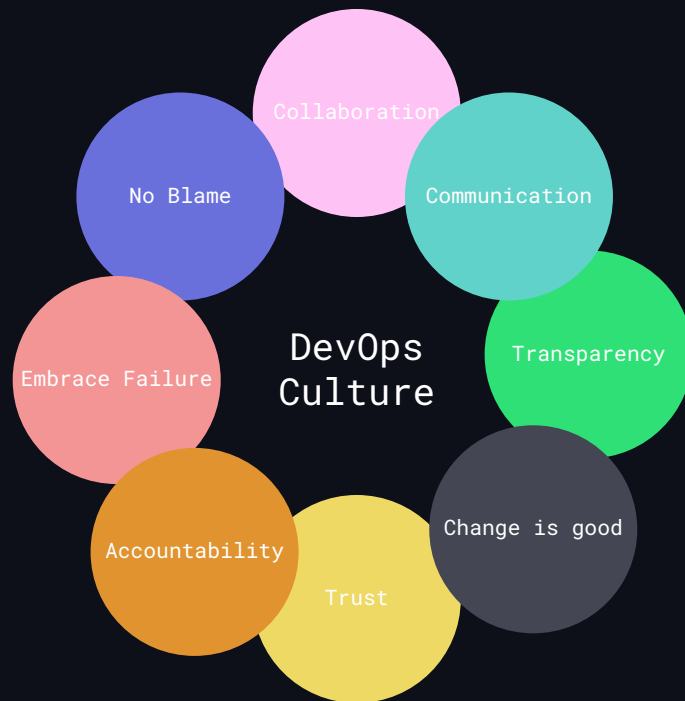
Goal: Move from physical data center to cloud

Success factors: Org structure - not just tools

Strategy: Embed DevOps engineers, encourage collaboration, break silos

Result: Reduced release time from 2 weeks to minutes

Lesson: Value of DevOps in cloud context



*A fleet of devices is like a
datacenter with intermittent
power and connectivity*

Improved collaboration

Boosted
communication
between teams for
faster problem-solving

Faster time-to-market

Streamlined processes
and automation for
quicker deployment

Enhanced reliability

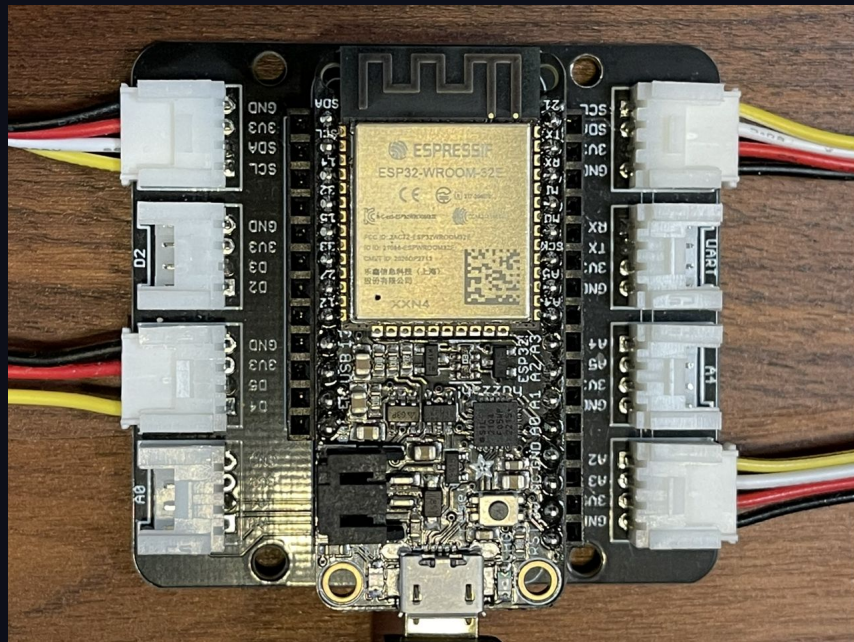
Automated testing and
continuous integration
for early error detection

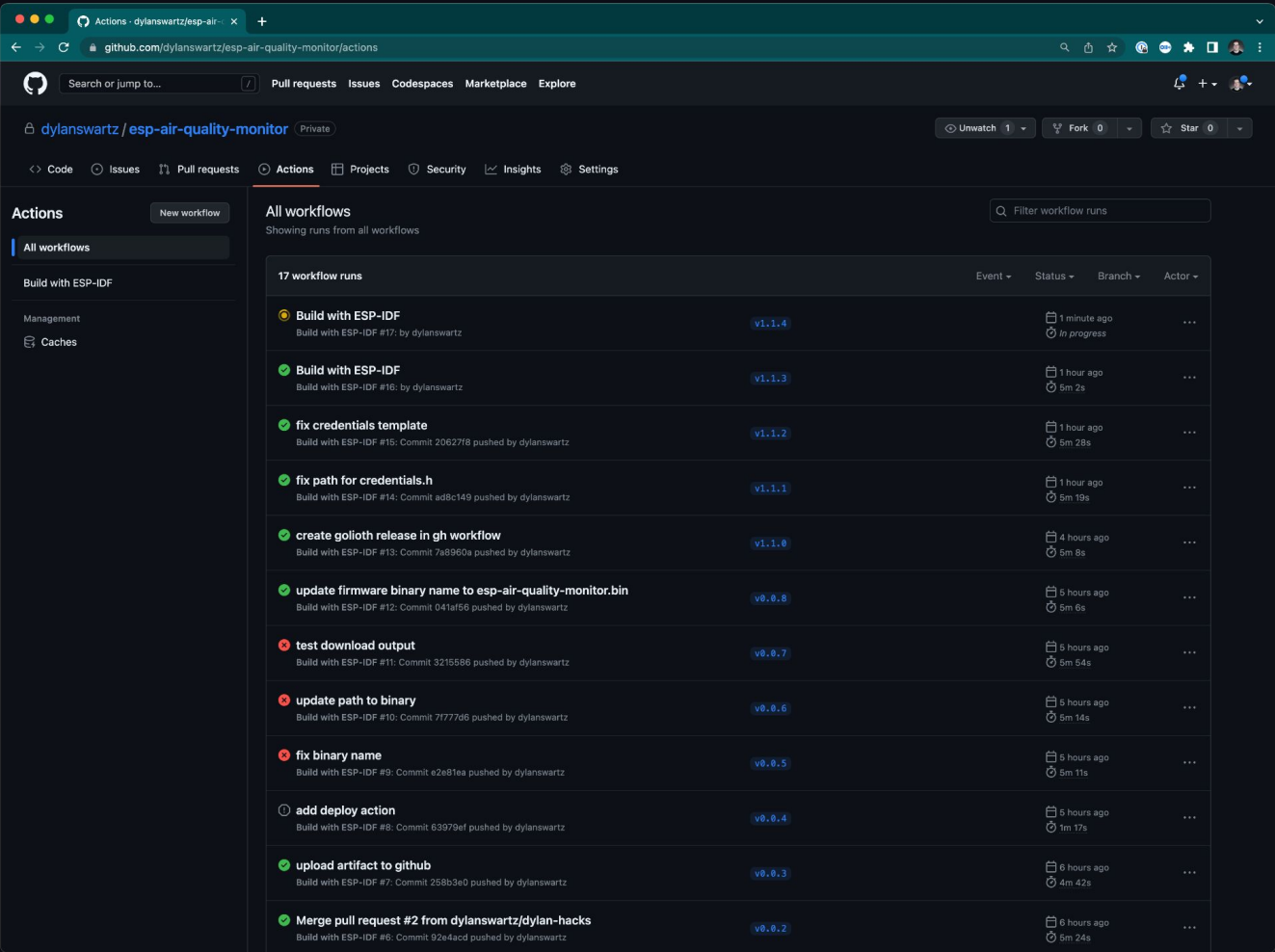
Scalability

provision and ship out
more and more devices
quickly.

Demo

- ESP32 with a featherboard and Grove sensors
- ESP-IDF with Arduino component and Golioth SDK
- GitHub Actions for CI/CD





Build with ESP-IDF · dylanswa... X

github.com/dylanswartz/esp-air-quality-monitor/actions/runs/4738003921

Search or jump to... Pull requests Issues Codespaces Marketplace Explore

dylanswartz / esp-air-quality-monitor (Private)

Unwatch 1 Fork 0 Star 0

Code Issues Pull requests Actions Projects Security Insights Settings

Build with ESP-IDF

Build with ESP-IDF #17

Cancel workflow ...

Summary

Jobs

build

Run details

Usage

Workflow file

Triggered via push 1 minute ago

Status

Total duration

Artifacts

dylanswartz · 9ea9c9c · v1.1.4

In progress

-

-

main.yml

on: push

build

1m 7s

deploy

https://github.com/dylanswartz/esp-air-quality-monitor/settings

← →

bump to v1.1.4 · dylanswartz/...

+

github.com/dylanswartz/esp-air-quality-monitor/actions/runs/473800392/workflow

🔒 ⭐ 🗨 📄 👤 ⋮

🔍 Search or jump to...

/

Pull requests

Issues

Codespaces

Marketplace

Explore

🔒 dylanswartz / esp-air-quality-monitor (Private)

👁 Unwatch 1

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🔼 Code

🔍 Issues

🔼 Pull requests

🔍 Actions

📁 Projects

🔒 Security

📄 Insights

⚙ Settings

← Build with ESP-IDF

🔴 Build with ESP-IDF #17

🔄 Re-run jobs

🕒 Latest #2

⋮

🏠 Summary

Jobs

🟢 build

🔴 deploy

Run details

🔍 Usage

📄 Workflow file

Workflow file for this run

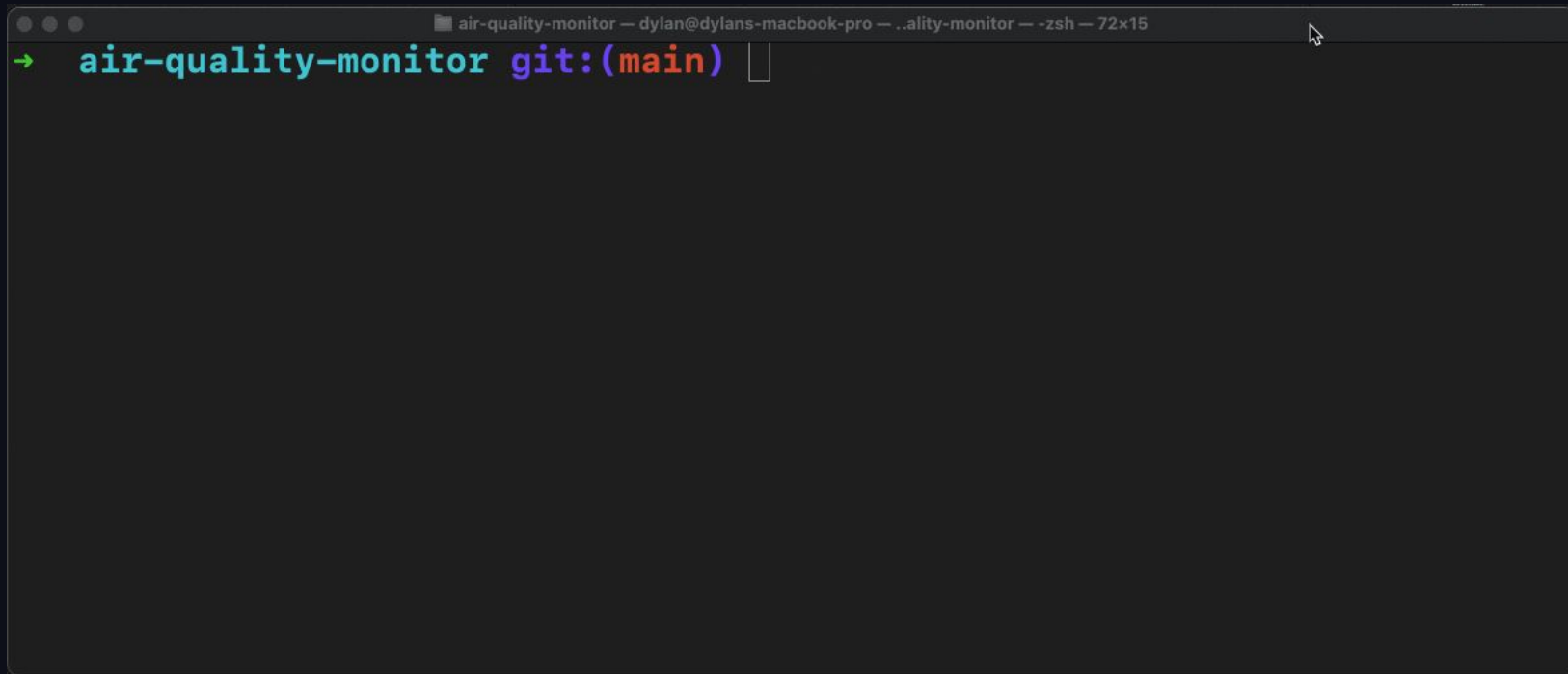
.github/workflows/main.yml at 9ea9c9c

```
1 name: Build with ESP-IDF
2
3 on:
4   push:
5     # Publish semver tags as releases.
6     tags: [ 'v*.*.*' ]
7   pull_request:
8     branches: [ main ]
9
10 jobs:
11   build:
12     runs-on: ubuntu-latest
13
14     steps:
15     - name: Checkout repo
16       uses: actions/checkout@v3
17       with:
18         submodules: 'recursive'
19     - name: esp-idf build
20       uses: espressif/esp-idf-ci-action@v1
21       with:
22         esp_idf_version: v4.4.4
23         target: esp32
24         path: './'
25     env:
26       WIFI_SSID: ${ secrets.WIFI_SSID }
27       WIFI_PASS: ${ secrets.WIFI_PASS }
28       PSK_ID: ${ secrets.PSK_ID }
29       PSK: ${ secrets.PSK }
30     - name: store built artifact
31       uses: actions/upload-artifact@v3
32       with:
33         name: firmware.bin
34         path: build/esp-air-quality-monitor.bin
35   deploy:
36     if: ${ github.event_name != 'pull_request' }
37     needs: build
38     runs-on: ubuntu-latest
39
40     steps:
41     - uses: actions/checkout@v3
42     - name: Install on the device
```




```
35 deploy:
36   if: ${github.event_name != 'pull_request' }}
37   needs: build
38   runs-on: ubuntu-latest
39
40   steps:
41     - uses: actions/checkout@v3
42     - name: Install goliothctl
43       run: |
44         echo "deb [trusted=yes] https://repos.golioth.io/apt/ /" | sudo tee /etc/apt/sources.list.d/golioth.list
45         sudo apt update
46         sudo apt install goliothctl
47     - name: Setup goliothctl
48       run: |
49         goliothctl login --apiKey ${secrets.GOLIOTH_API_KEY} --projectId ${secrets.GOLIOTH_PROJECT_ID}
50     - uses: actions/download-artifact@v3
51       with:
52         name: firmware.bin
53     - name: Test artifact download
54       run: ls -R
55
56     - name: Get latest release version number
57       id: get_version
58       uses: battila7/get-version-action@v2
59
60     - name: Upload binary to Golioth (create artifact)
61       run: |
62         goliothctl dfu artifact create esp-air-quality-monitor.bin --version ${steps.get_version.outputs.version-without-v}
63
64     - name: Create release in Golioth (OTA update)
65       run: |
66         goliothctl dfu release create --components main@${steps.get_version.outputs.version-without-v} --tags dev --rollout true
```

```
40 steps:
41   - uses: actions/checkout@v3
42   - name: Install goliothctl
```



A terminal window with a dark background. The title bar at the top reads "air-quality-monitor — dylan@dylans-macbook-pro — ..ality-monitor — -zsh — 72x15". The prompt is a green arrow pointing to the text "air-quality-monitor" in cyan, followed by "git:(main)" in purple and red, and a white cursor block.

```
→ air-quality-monitor git:(main) |
```

Golioth

Projects

Jade Furious Wildcat

Dashboard

Devices

Blueprints

Tags

Device Settings

Monitor

Firmware Updat...

API Keys

Certificates

Output Streams

Users

Feedback

Devices - Golioth

console.golioth.io/devices

Devices

Jade Furious Wildcat (...)

Docs

Dylan Swartz

Tag Filter

dev test temp

Devices

Search by Name or Hardware ...


Available Disabled

| <input type="checkbox"/> Name | Blueprint | Primary Hardware ID | Tags | Connection Status | Last report |
|---|-----------|---|------|--------------------------|-------------------|
| <input type="checkbox"/> huzzah-feather-board | - | 20230218230213-huzzah-feather-board | dev | online a few seconds ago | a few seconds ago |
| <input type="checkbox"/> blush-anonymous-leopard | - | 20230323002314-blush-anonymous-leopard | - | offline | - |
| <input type="checkbox"/> black-legal-turtle | - | 20230323002321-black-legal-turtle | - | offline | - |
| <input type="checkbox"/> black-crucial-cattle | - | 20230323002324-black-crucial-cattle | - | offline | - |
| <input type="checkbox"/> azure-rising-squid | - | 20230323002326-azure-rising-squid | - | offline | - |
| <input type="checkbox"/> white-effective-silkworm | - | 20230323002327-white-effective-silkworm | - | offline | - |

1-6 of 6 items < 1 >

Artifacts - Golioth

console.golioth.io/artifacts



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Docs

 Dylan Swartz

Artifacts

Search by package

Search by version

Select a blueprint

☐

Package

☐

Version

☐

Blueprint

☐











Size

☐

Type

☐

Hash


| | | | | | | |
|--------------------------|------|-------|---|--------|---|--|
| <input type="checkbox"/> | main | 1.1.4 | - | 994 kB | - | f1d34a7547565e...  |
| <input type="checkbox"/> | main | 1.1.3 | - | 994 kB | - | fa8c2f34ec21738...  |
| <input type="checkbox"/> | main | 1.1.2 | - | 994 kB | - | 2d73c313179d14...  |
| <input type="checkbox"/> | main | 1.1.1 | - | 994 kB | - | 89fff9935898bc4...  |
| <input type="checkbox"/> | main | 1.1.0 | - | 994 kB | - | 849a47900e51a4...  |
| <input type="checkbox"/> | main | 0.0.8 | - | 994 kB | - | 3e665837dfd2ae...  |
| <input type="checkbox"/> | main | 1.0.5 | - | 994 kB | - | 5cd13180f630d1...  |
| <input type="checkbox"/> | main | 1.0.4 | - | 992 kB | - | 0ddaa00758bad1...  |
| <input type="checkbox"/> | main | 1.0.3 | - | 992 kB | - | 655ae2d07e9f78...  |
| <input type="checkbox"/> | main | 1.0.2 | - | 975 kB | - | 34e71df4d7458a...  |

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Golioth

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- Jade Furious Wildcat
- Dashboard
- Devices
- Blueprints
- Tags
- Device Settings
- Monitor
- Firmware Updat...
- Artifacts
- Releases**
- API Keys
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- Output Streams
- Users
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Releases

Releases

Tag Filter: dev test temp


Release updated successfully

Docs Export.csv Create

Search by Release Fla... Select a blueprint Filter by rollout flag

| Seq. Number | Release Flags | Artifacts | Blueprint | Device Tags | Created | Suit Manifest | Rollout |
|--|---------------|--------------|-----------|-------------|---------------|---------------|-------------------------------------|
| <input type="checkbox"/> 1681879717960248941 | - | main - 1.1.4 | - | dev | 5 minutes ago | ... | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> 1681857350563755947 | - | main - 1.1.3 | - | dev | 6 hours ago | ... | <input type="checkbox"/> |
| <input type="checkbox"/> 1681857172767256559 | - | main - 1.1.2 | - | dev | 6 hours ago | ... | <input type="checkbox"/> |
| <input type="checkbox"/> 1681855463799321130 | - | main - 1.1.1 | - | dev | 7 hours ago | ... | <input type="checkbox"/> |
| <input type="checkbox"/> 1681844833325854579 | - | main - 1.1.0 | - | dev | 10 hours ago | ... | <input type="checkbox"/> |

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console.golioth.io/devices

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|---|-----------|---|------|---------------------|-------------------|
| <input type="checkbox"/> huzzah-feather-board | - | 20230218230213-huzzah-feather-board | dev | online a minute ago | a few seconds ago |
| <input type="checkbox"/> blush-anonymous-leopard | - | 20230323002314-blush-anonymous-leopard | - | offline | - |
| <input type="checkbox"/> black-legal-turtle | - | 20230323002321-black-legal-turtle | - | offline | - |
| <input type="checkbox"/> black-crucial-cattle | - | 20230323002324-black-crucial-cattle | - | offline | - |
| <input type="checkbox"/> azure-rising-squid | - | 20230323002326-azure-rising-squid | - | offline | - |
| <input type="checkbox"/> white-effective-silkworm | - | 20230323002327-white-effective-silkworm | - | offline | - |

1-6 of 6 items < 1 >



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Managing a Device

Devices / Device 20230218230213-huzzah-feather-board

Jade Furious Wildcat (...)

Docs

Dylan Swartz

Quick Access

Show disabled devices: ☐

Name or Hardware ID

huzzah-feather-board
20230218230213-huzzah-feath...

blush-anonymous-leopard
20230323002314-blush-anony...

black-legal-turtle
20230323002321-black-legal-tu...

black-crucial-cattle
20230323002324-black-crucial-...

azure-rising-squid
20230323002326-azure-rising-s...

white-effective-silkworm
20230323002327-white-effectiv...

6 device(s). Search for more results...

Summary Credentials Firmware LightDB State LightDB Stream Logs Settings Remote Procedure Call

Summary Delete Edit

Identity

Device Name huzzah-feather-board

Blueprint -

Primary Hardware ID 20230218230213-huzzah-feather-board

Device Id 63f158f5562f4d2ace23b792

Tags
dev

Firmware

| Package | Version |
|---------|---------|
| main | 1.1.3 |

History

Updated a month ago

Created 2 months ago

Status

Connection Status online a minute ago

Last Report a few seconds ago

Setting Sync In sync a minute ago


Services

LightDB State

LightDB Stream

Logs

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Managing a Device - Golioth

console.golioth.io/devices/63f158f5562f4d2ace23b792/management/firmware

Managing a Device

🏠 / 📁 Devices / 📁 Device 20230218230213-huzzah-feather-board

Jade Furious Wildcat (...)

📄 Docs 📁 🧑 Dylan Swartz

Quick Access

Show disabled devices: ☐

Name or Hardware ID 🔍

huzzah-feather-board

20230218230213-huzzah-feath...

blush-anonymous-leopard

20230323002314-blush-anony...

black-legal-turtle

20230323002321-black-legal-tu...

black-crucial-cattle

20230323002324-black-crucial-...

azure-rising-squid

20230323002326-azure-rising-s...

white-effective-silkworm

20230323002327-white-effectiv...

6 device(s). Search for more results...

Summary Credentials **Firmware** LightDB State LightDB Stream Logs Settings Remote Procedure Call

Firmware 🔄

| Package | Version | Target | State | Reason | Updated |
|---------|---------|--------|-------------|-------------|-------------------|
| main | 1.1.3 | 1.1.4 | DOWNLOADING | ready state | a few seconds ago |

*Certificate-based
authentication and automated
provisioning of devices*

Golioth's Certificate-Based Authentication

- Simplifies registration for numerous devices
- Prevents exposure of symmetrical keys
- Easy 3-step implementation:
 - Generate self-signed root certificate
 - Upload root certificate public key to Golioth
 - Generate device certificates



<https://blog.golioth.io/introducing-golioth-certificate-based-authentication/>

IoT DevOps in Clinical Trials

Company Overview:

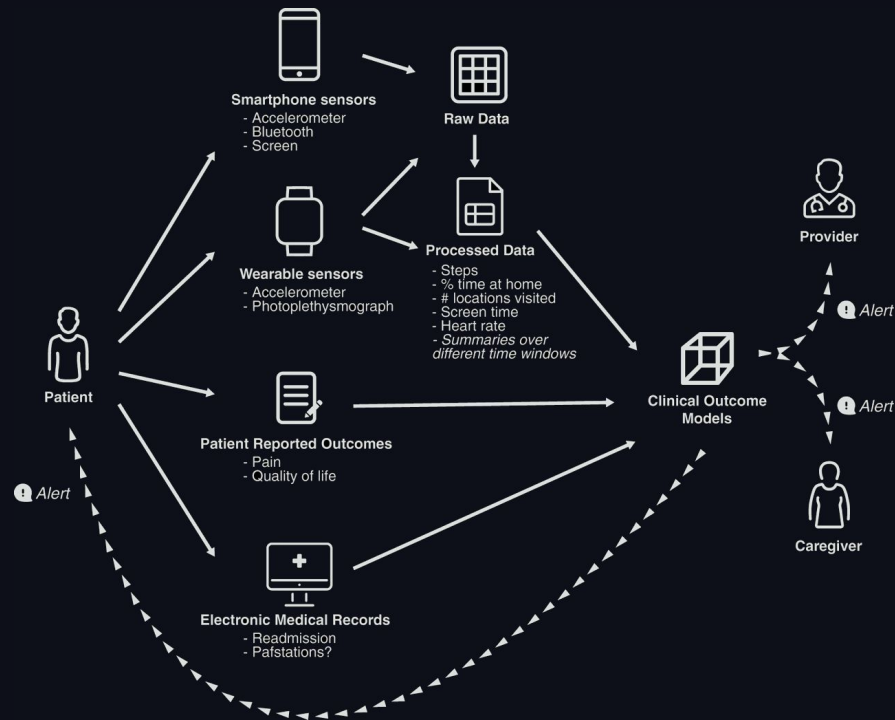
- Building devices for clinical drug trials
- Struggling with timelines for delivery

Implemented DevOps methodologies:

- CI/CD and automated provisioning
- Integration with inventory system
- Collaborative effort between devs and operations team

Results:

- Increased shipping capacity from 300 to 3,000 devices per month



Thank you!

Golioth Dev Tier

50 devices free!

<https://console.golioth.io>

Getting Started: <https://docs.golioth.io>

Contact us: devrel@golioth.io