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101 for JFrog Connect - Workshop

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Developer Advocate at JFrog

https://jfrog.com/connect/

```
git clone https://github.com/NickR2600/ConnectDemo01.git
```

My Background

Robots

- Programmed in Interactive (IC)
- C syntax and custom functions
  - Effectors: motors, servos
  - Sensors: IR distance, sonar, camera
- Controllers
  - Fred Martin's Handy Board
  - Charmed Labs' XBC

Games

- PS3, Xbox 360, DS, Wii, 3DS, iOS, Android, web
- Flex/Action Scripting, lua, JavaFX, C#, SQL
- Java training and certification, Oracle Cloud

XBC taken by KIPR and Charmed Labs http://dpm.kipr.org/papers/xbc-iros05.pdf

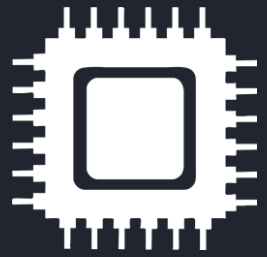
About JFrog Connect

- Manage connected devices at scale
  - Internet of Things (IoT)
  - Edge computing
- Update, control, monitor and secure remote Linux IoT devices with the click of a button.
  - These are performed over a network connection, also known as **over the air** (OTA)

Topics

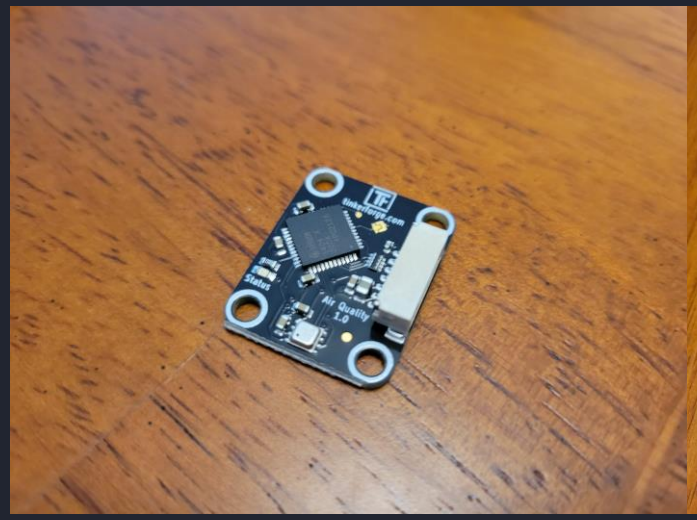
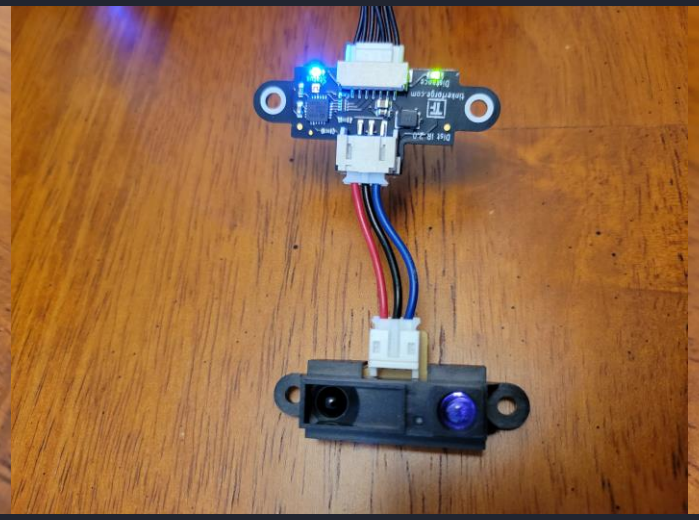
- The Story of Chips, Sensors, and Devices
  - What are IoT and edge computing?
  - Industry use-cases, potentials, and risks
- **Lab 1**: Readying a Raspberry Pi (RPi) or Virtual Demo Device
  - Required RPi hardware and setup
  - Access a free-tier instance of Connect
  - Register a device using Connect and the Connect Agent
  - What is the Connect Agent?
- OTA Updates
  - **Lab 2**: Push files to a device, compile, and run
  - **Lab 3**: Update a device while its program runs
- At Scale
  - Tips and good practices
  - Security considerations

The Story of Chips and Things

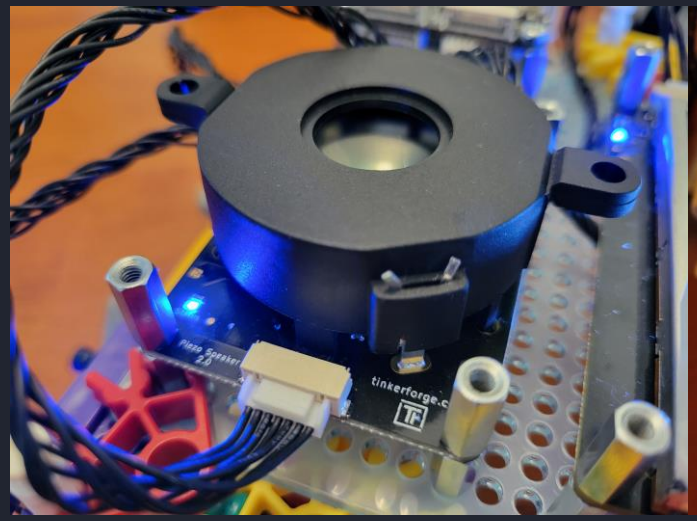
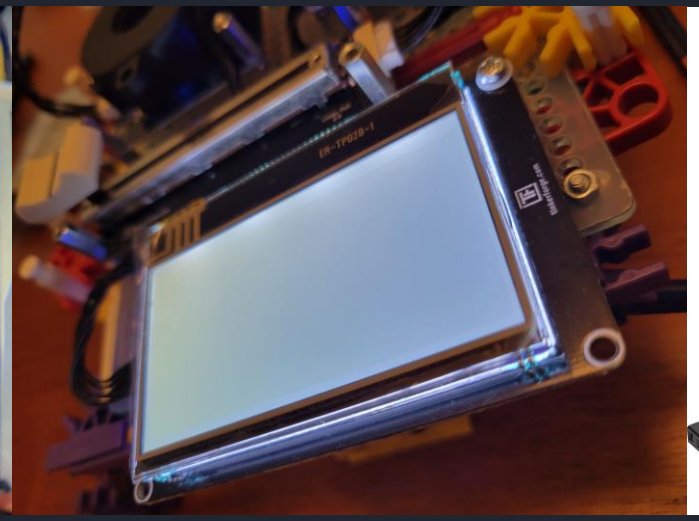


Where do Things Come From?

- Sensors:


- Output devices and effectors: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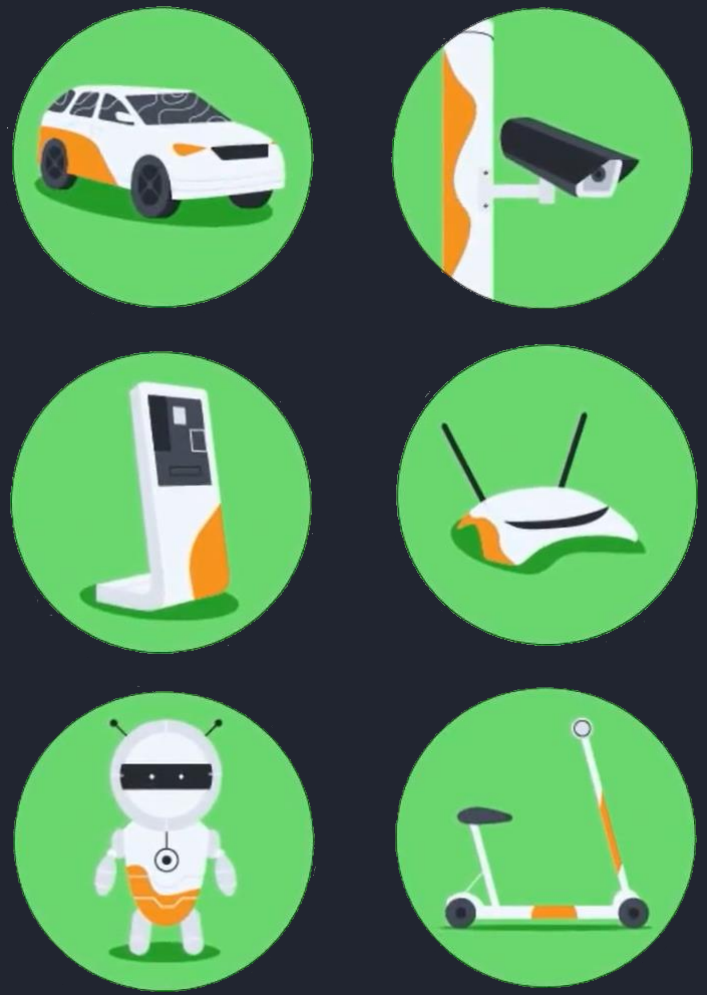
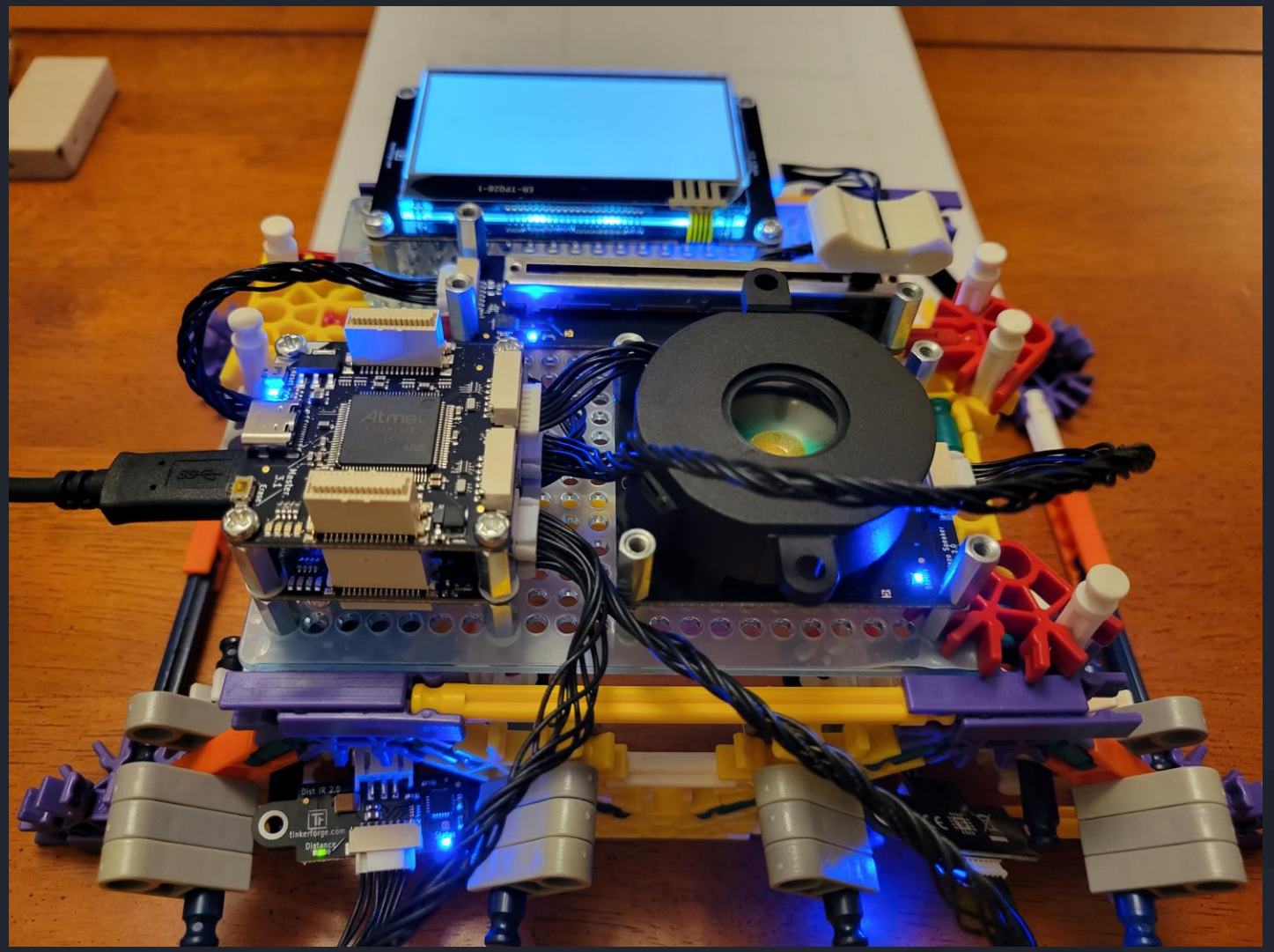
Combining Elements into a Thing/Device





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Scenario 1

- A car is equipped with sensors to detect:
  - Velocity
  - Road conditions (slippery?)
  - Distance to other objects
- The car should engage brakes to prevent collisions and save lives

A World of Only Sensors

- Sensors collect data
- Sensors cannot compute or make decisions
- Data may be sent to a regional or central server for computation
- The server tells devices to perform actions based on the results of a computation

Scaling This Model

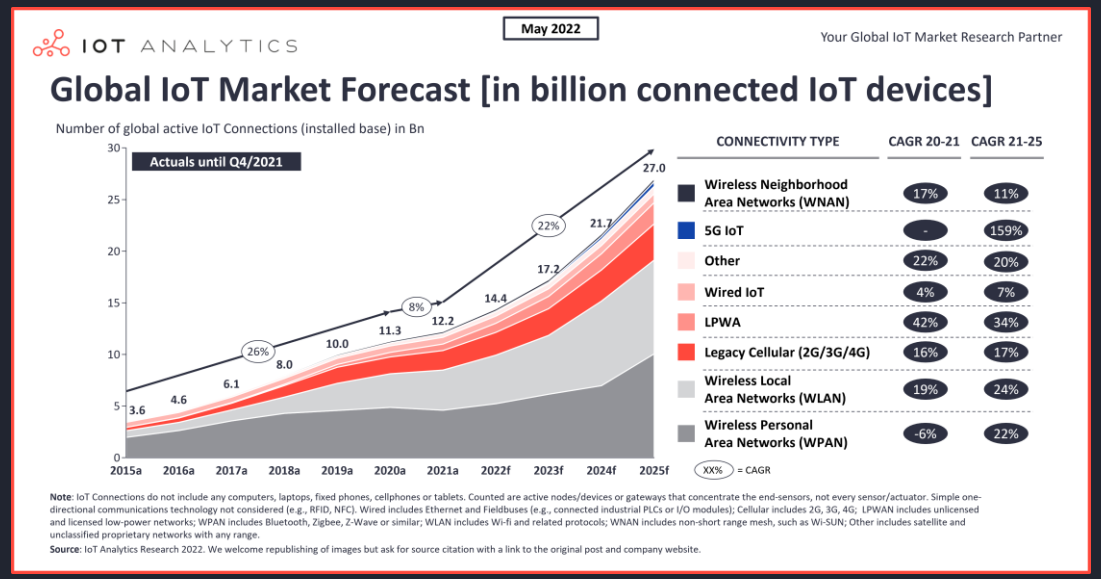
- There are a lot of sensors and data in the world
  - According to iot-analytics.com:
    - 2015: 3.6 billion
    - 2020: 11.3 billion
    - 2025: 27 billion
- Does your infrastructure have the throughput and processing power?
- Can your scenario afford a ~133ms delay?
  - The time required to travel the circumference of Earth at the speed of light
- At scale, this model can become overwhelmed, inefficient, and time consuming

Edge Computing

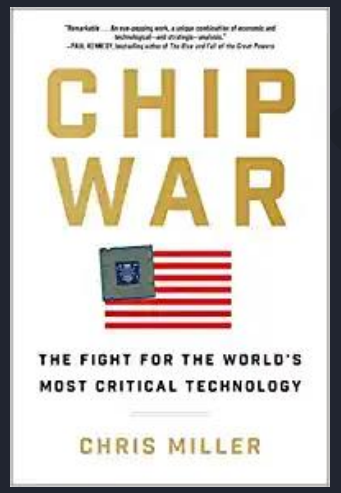
- Devices possess or access local computing ability
  - Computing occurs at the edges of networks
  - The amount of computing power at an edge is a design choice
- Devices also talk to each other, not just a central/regional hub.
  - Creating an internet of things

The Near Future of Devices

- According to iot-analytics.com:
  - 2015: 3.6 billion
  - 2020: 11.3 billion
  - 2025: 27 billion



- US policies restrict China's access to foreign chips and ability to manufacture their own
- Glut of High and Medium value chips (CNBC Mad Money, January 24, 2023)
- Low value chip demand outpaces supply
  - Older hardware must last longer
  - More judicious and value-add usage
  - Increase longevity with OTA updates



- Chris Miller

  Associate Professor of International History

  Tufts University

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Value Chips and Value-Add

Low Value Chips (IoT)

- Smart LEDs
- Smart Fridge
- Climate Control System

Medium Value Chips

- Automotive

High Value Chips

- AI/ML
- Military
- Computers and Smartphones

Low Value-Add

- Your fridge texts that you're out of milk
- Humans can make their own shopping lists

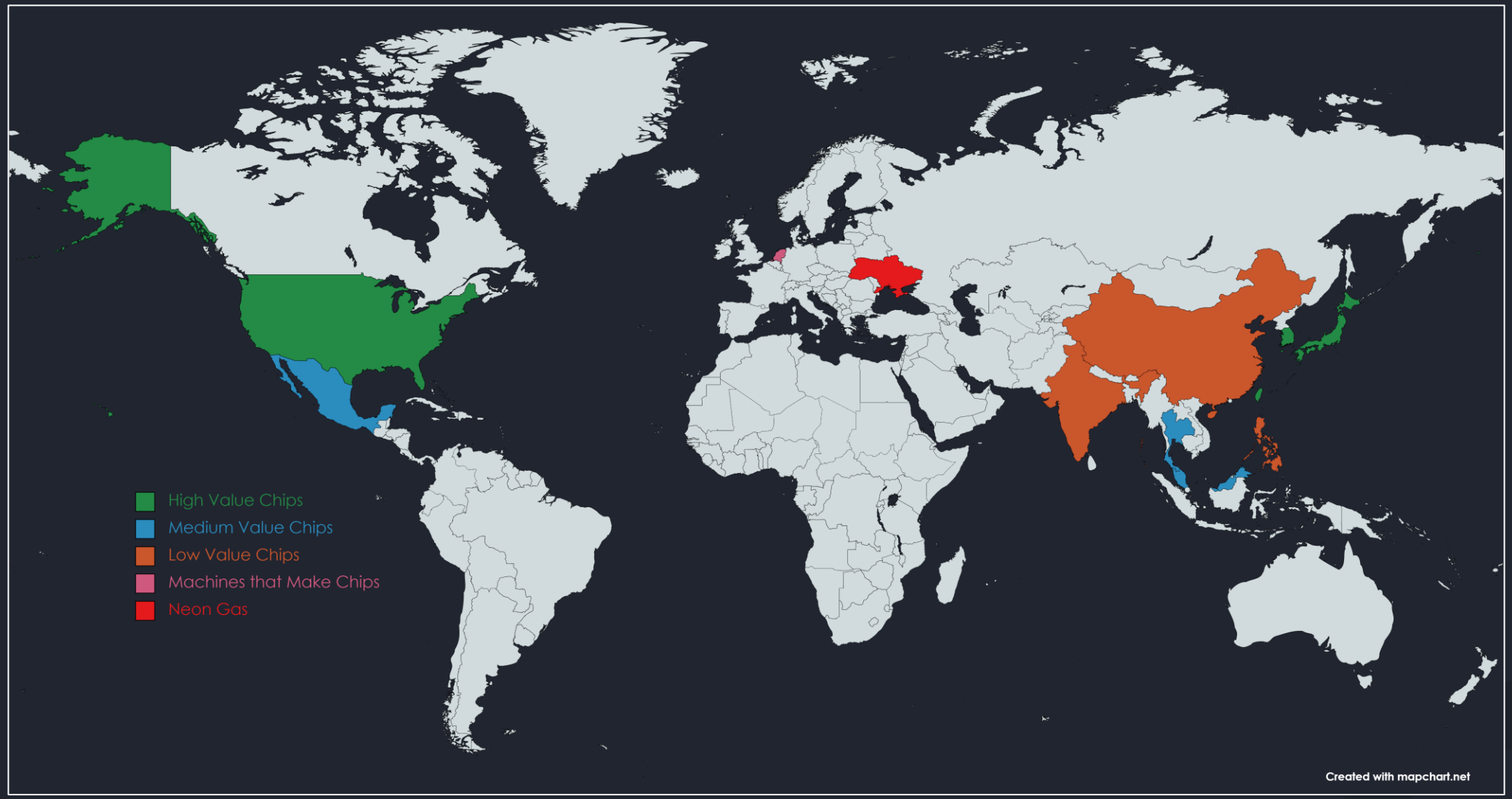
Medium Value-Add

- Your fridge finds coupons and deals to save you money

High Value-Add

- Technology is used to grow more food

Map of Chip Manufacturing



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A Value-Add Use-Case

Request from Sonnetopolis

Sonnetopolis sends a desperate greeting. Our humble culture finds its fate fleeting. Man does not live on bread alone. But we cannot feed our people with a poem. We need **potash** to make our land fertile. Please find a trading nation to help with this hurtle.

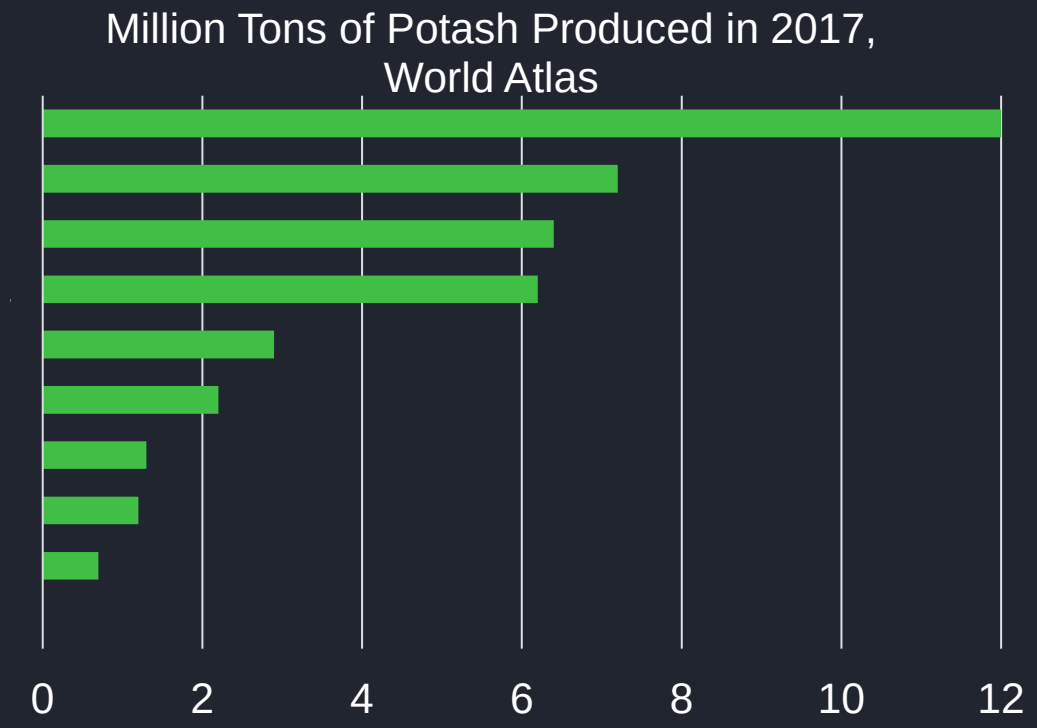
About Sonnetopolis:

- Population: 4,000,000
- Exports: Poetry
- Natural Resources: Very limited
- Agriculture: Grows its own food but relies heavily on imports to make fertilizer

About Potash:

- Potassium salt compounds (KCl, K_2SO_4, KNO_3)

Who is a Good Trading Partner?



Top Potash Producing Countries:

Belarus	Canada	Chile
China	Germany	Israel
Jordan	Russia	Spain

Canada
Everyone loves Canadian potash! Other countries are outbidding us and driving up the price. We can only get 25% of the potash we need.

Russia, Belarus
Pariah states created a war zone. Other trading partners will punish us.

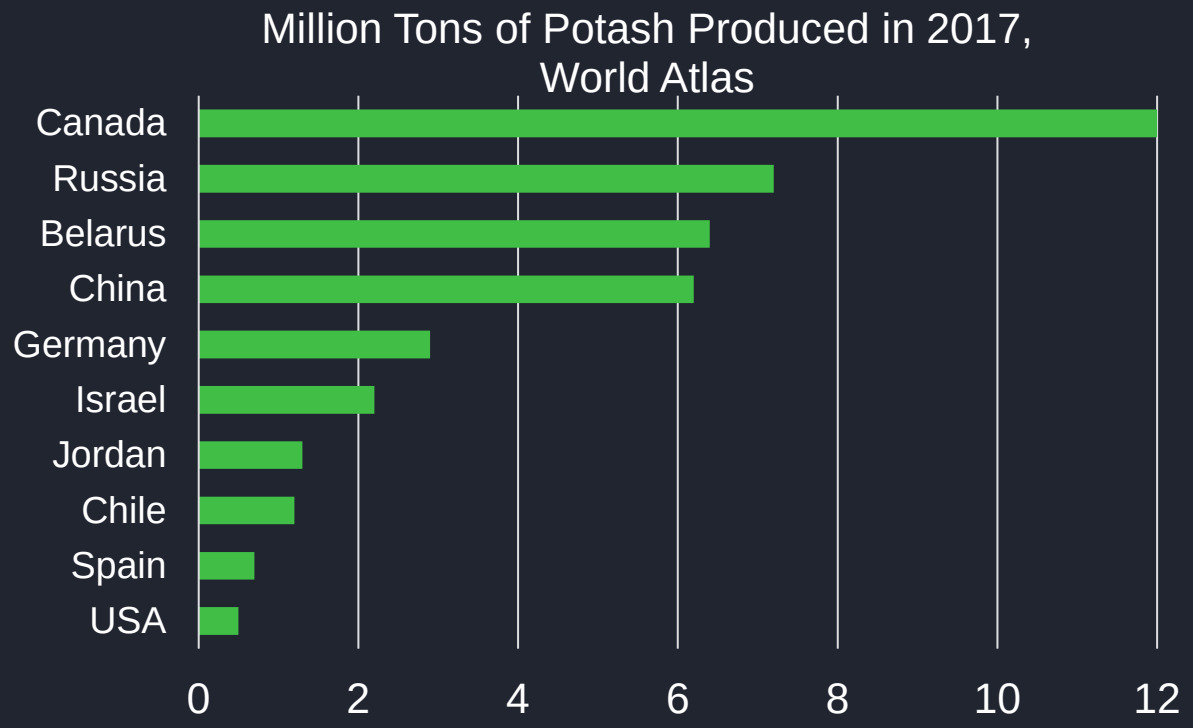
China
Phosphate exports were banned. Potash is next.

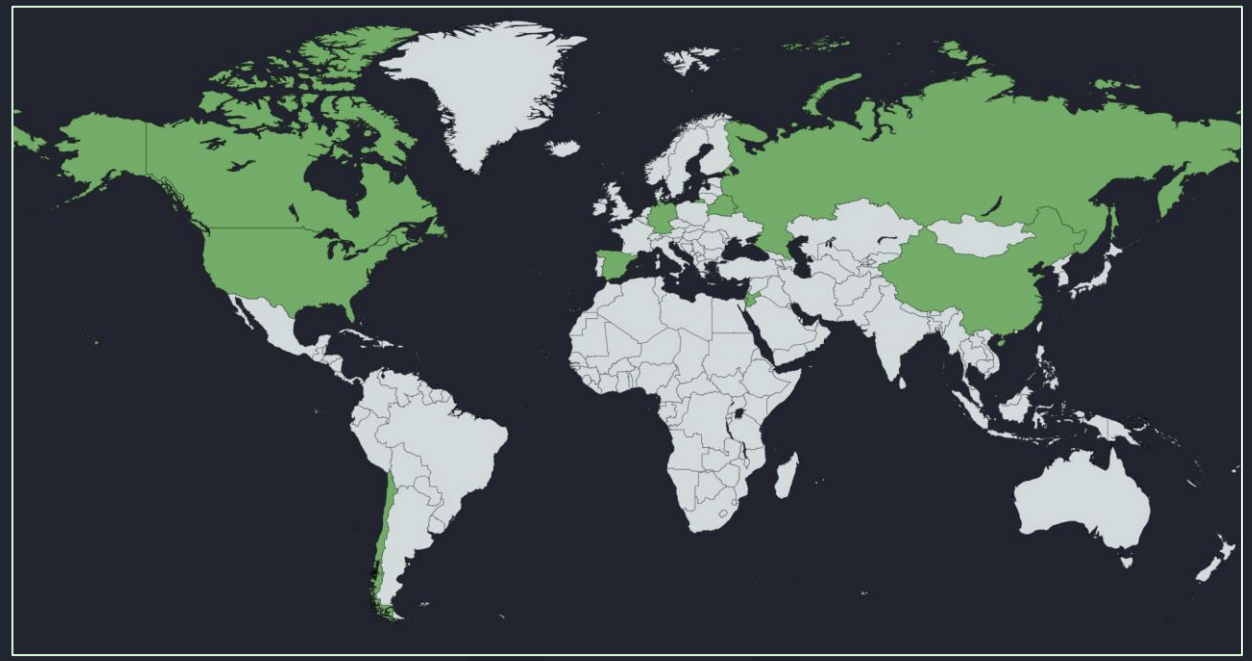
Germany
They won't trade for poems... only liquified natural gas or other forms of energy.

Israel
They can offer 10% of what we need.

Jordan, Chile, Spain
None to spare. What's produced is consumed.

The Agriculture Takeaway





Fertilizer and its ingredients come from a small number of countries. They're susceptible to supply chain disruptions and geopolitics (https://www.cnbc.com/2022/03/22/fertilizer-prices-are-at-record-highs-heres-what-that-means.html)

Scenario 2: AI and IoT Farming

- **Double crop yields**
- Consume only **a quarter of the inputs**
- Sensors monitor crop rows and detect the optimal time to introduce inputs
- According to geopolitical strategist Peter Zeihan (https://www.youtube.com/watch?v=LzipwDQBUyc, @51:20)

John, a Sonnetopolis arable farmer, uses smart devices in his fields which monitor soil moisture, analyze this data, and use it to regulate irrigation. However, the application that has been shipped with those devices has a fault that sporadically stops the irrigation on hot days. The consequences of this software bug are potentially devastating: his entire crop could be lost.

Updating Devices

Manual updates:

- Take an SD card or flash drive to each device
- Are devices in inconvenient locations or inaccessible?
- Did you miss a device?
- This process does not scale well

JFrog CONNECT

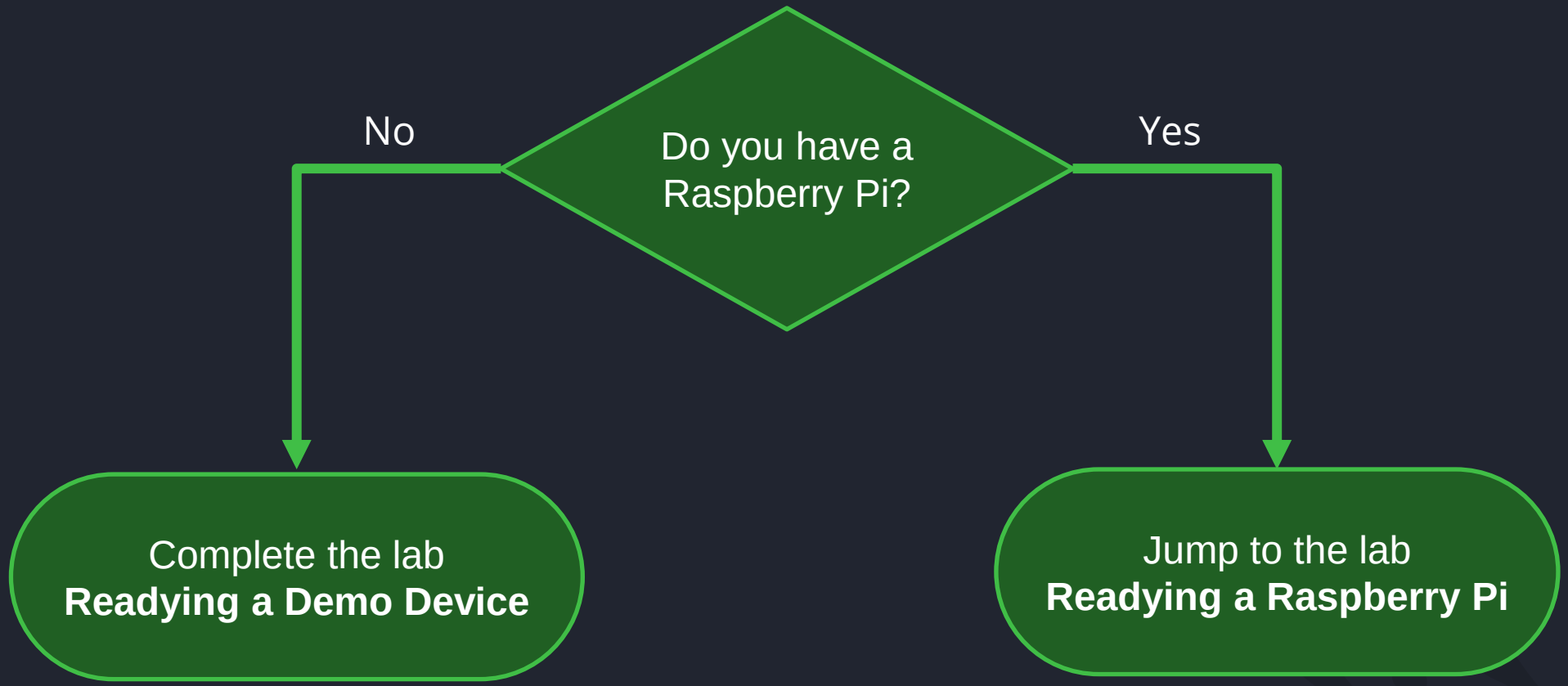
OTA updates:

- Reach many devices at once
- Fail-safe (Rollback if necessary)
- Division between different types and models
- Monitor devices' health

Device requirements:

- Linux
- Network connection
- Install the Connect Agent

Choose a Setup Lab



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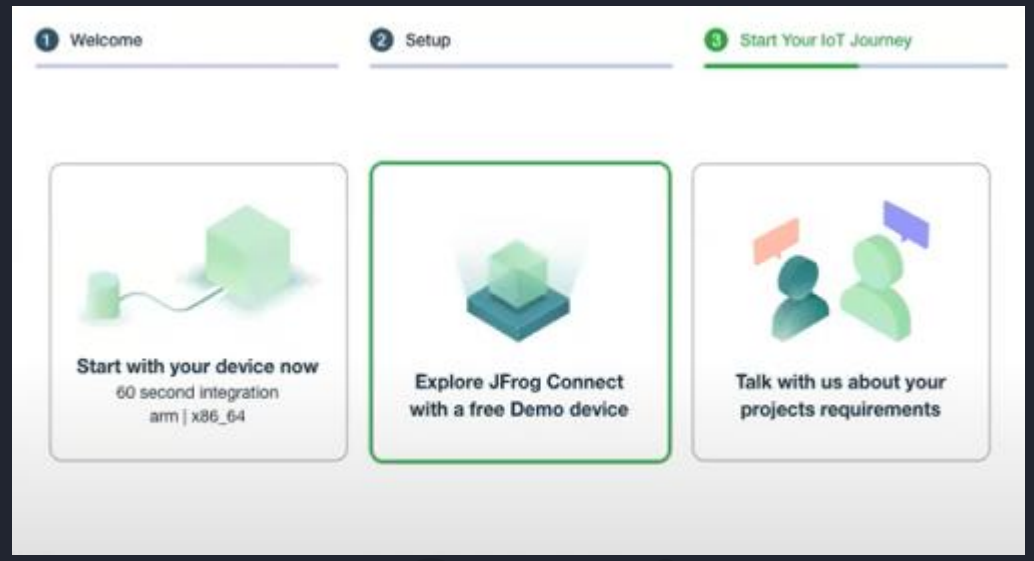
Readying a Demo Device

Create a Demo Device

1. Log in to your JFrog Connect account or choose Start for Free: https://jfrog.com/connect/
2. Select **Explore JFrog Connect with a free Demo Device**
3. Name your project

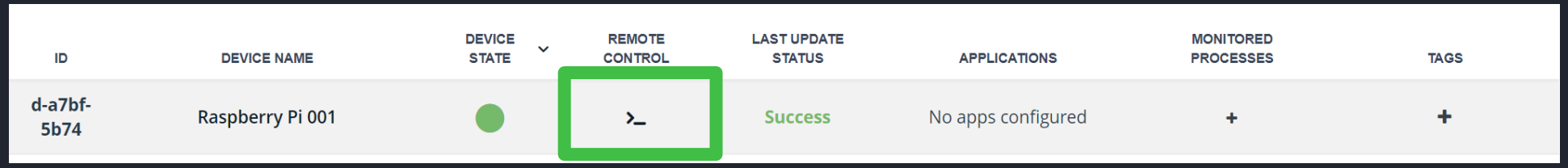


Notes:

- The device should be ready in about one minute
- Try refreshing your browser if it doesn't automatically show in the Devices list
- The device is generated with the Connect Agent already installed.

Create the User `pi`

4. Click the button for remote control access to the device. Within a few seconds, a reverse SSH tunnel is created. You will do this as the user **`root`**. Click **Connect**



5. Create the user **`pi`** user and give it a password:

```
useradd -m pi
passwd pi
```

6. Switch to the user **`pi`**:

```
su - pi
```

7. Jump to **Step 14** of the lab **Readying a Raspberry Pi**

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Readying a Raspberry Pi

Required Hardware

1. Raspberry Pi
2. Power adapter
3. SD Card
4. HDMI Cable
5. Monitor
6. USB keyboard
7. Wifi adapter or ethernet connection

Our setup includes a Raspberry Pi 1 Model B, 4GB SD card, and NetGear wifi adapter A6150. Older RPi models like this don't include built-in wifi support.

Flash a Linux Image

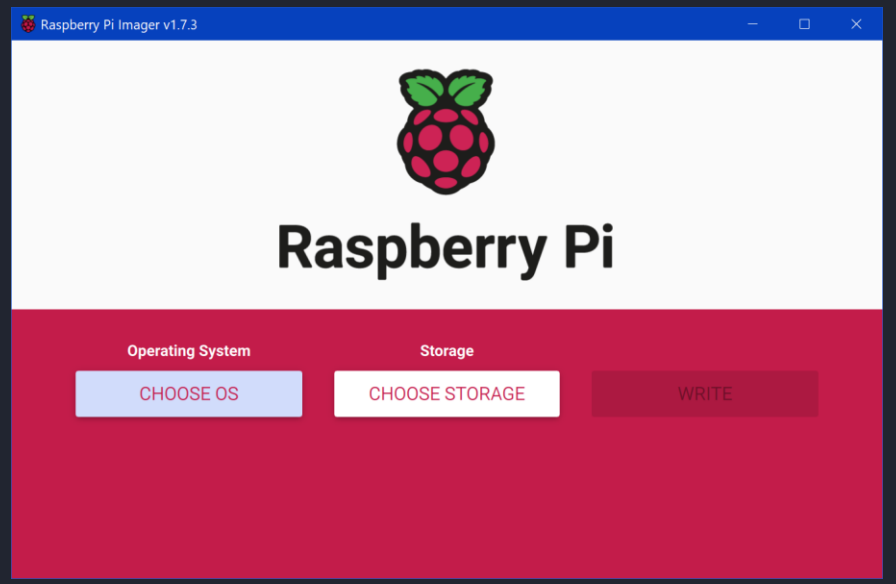
1. Download and run the Raspberry Pi Imager: https://www.raspberrypi.com/software/
2. Choose a Raspberry Pi OS. These are all Debian Linux variants. Your choice will depend on your SD card size and Raspberry Pi model:

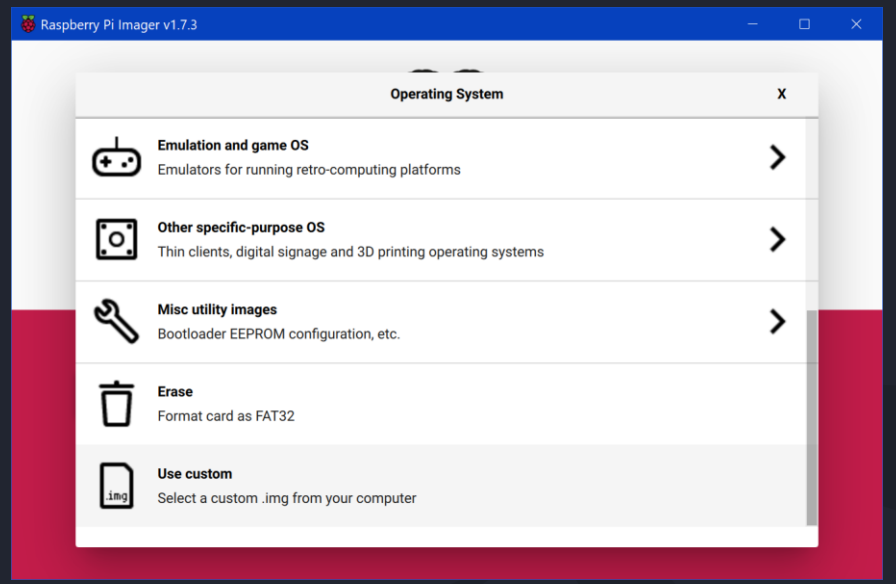
   - For smaller SD cards, choose options with no desktop environment

   - For older RPi models with no built-in wifi, choose an older OS. These are more likely to have available wifi adapter drivers.

   - We chose “Use custom” and downloaded the 2020-05-28 Debian Buster image: https://downloads.raspberrypi.org/raspios_lite_armhf/images/

3. Choose the SD card and write the image





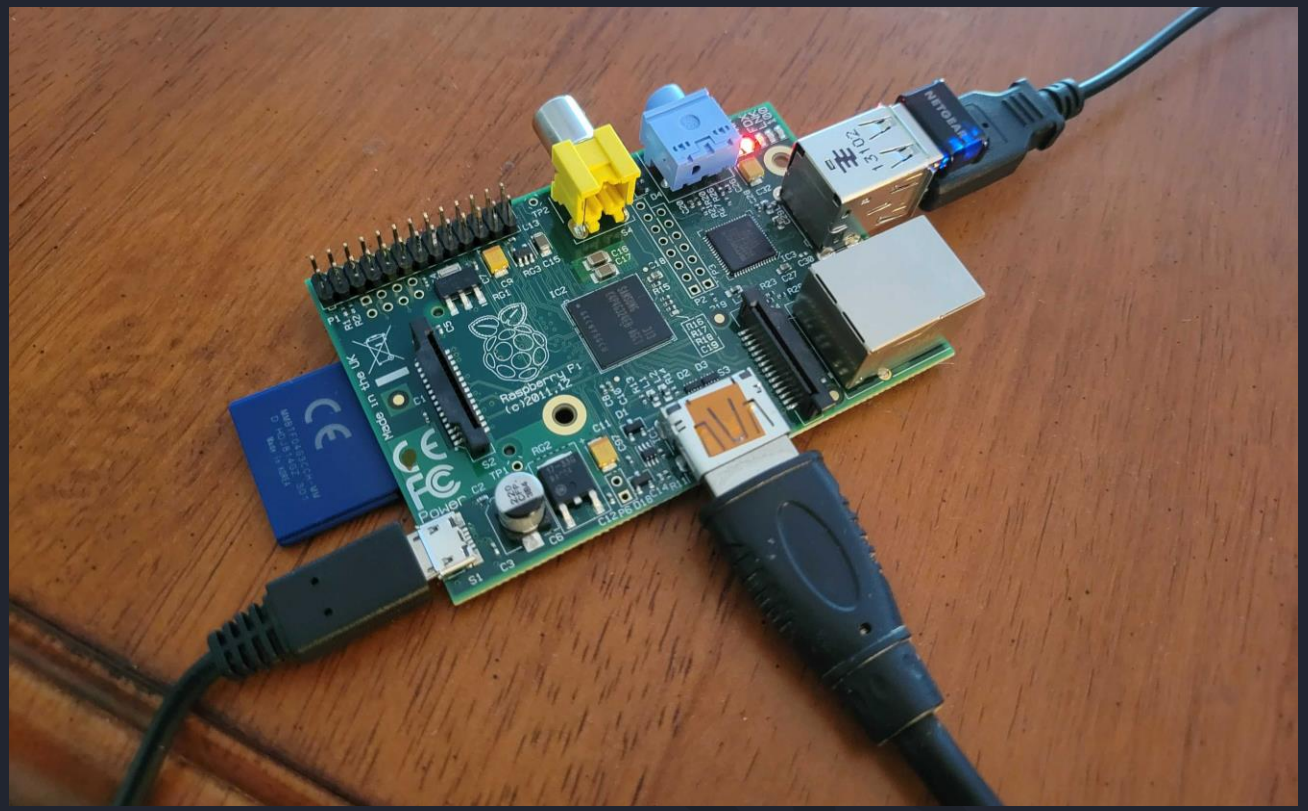
Power On

4. Insert the SD card in the RPi
5. Power on the RPi
6. Login

   For older OS images, the default login may be:

   - Username: pi

   - Password: raspberry



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Ready the Wifi

Skip step 7 if you don't need to find a wifi adapter driver.

7. Install the wifi adapter driver (this assumes you have a wired connection):

    - MrEngman wrote an excellent tool to retrieve the correct driver: https://forums.raspberrypi.com/viewtopic.php?t=241593

    - In the terminal, enter the following:

```
sudo wget http://downloads.fars-robotics.net/wifi-drivers/install-wifi -O /usr/bin/install-wifi
sudo chmod +x /usr/bin/install-wifi
sudo install-wifi
```

    - If a driver isn't found, you may need to use a different wifi adapter or OS version. Or find a driver manually. Otherwise, remove the wired connection. You should be all set.

8. Enter **`sudo raspi-config`**

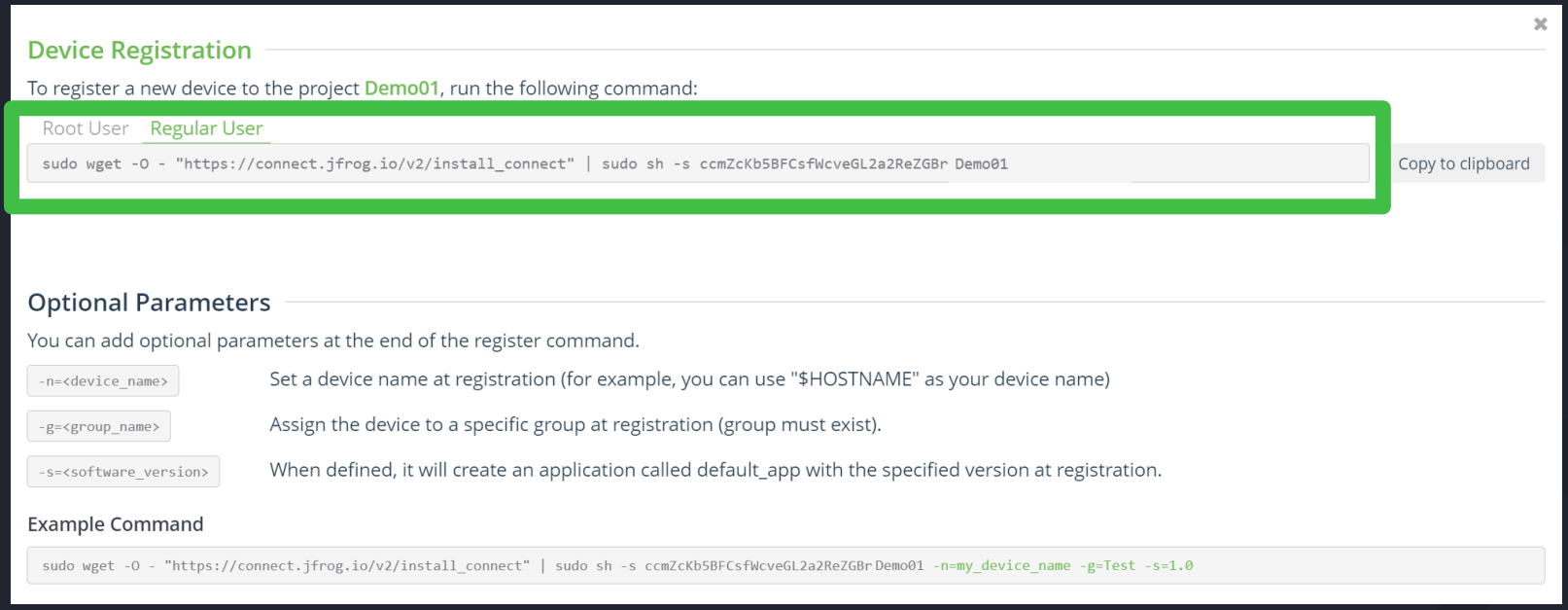
    - In Localisation Options, set the WLAN Country

    - In Network Options, set the SSID and passphrase for your network

Download the Connect Agent

9. Log in to your JFrog Connect account or choose Start for Free: https://jfrog.com/connect/
10. Once you're logged in, select **Start with your device now** and name your project
11. Select **Register Device**
12. Enter either of the two statements shown into the RPi terminal.

The RPi should be connected in a matter of seconds.



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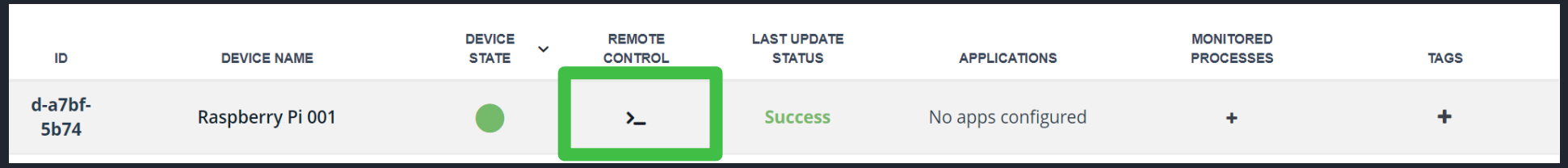
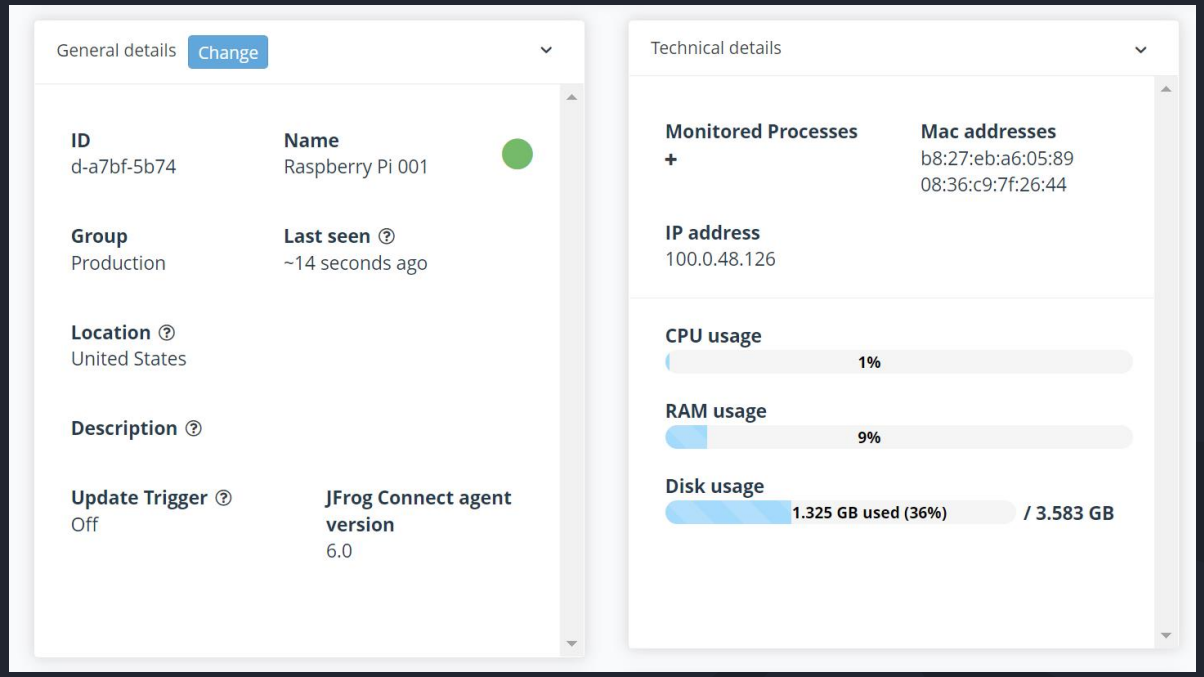
Test the Connection (Optional)

13. Click the button for remote control access to the device. Within a few seconds, a reverse SSH tunnel is created. Click **Connect**.



14. Enter `sudo reboot now` in the remote terminal. The actual RPi will reboot, and the remote terminal should close automatically. Rebooting the RPi isn't necessary. It's just an obvious action you can use to prove the connection works.

15. Scroll down in Connect. You should find modifiable general details about the device, as well as see technical details.



About the Agent

- Stealthy memory footprint:

  ~4MB of diskspace

  ~11MB of RAM

- Always on

  - Periodically checks with Connect servers

  - Every 15 seconds by default (in the trial version of Connect)

  - Period is changeable in **Settings**

  - Communicates client-side via port 443 (HTTPS) or 80 (HTTP)

  - Independent

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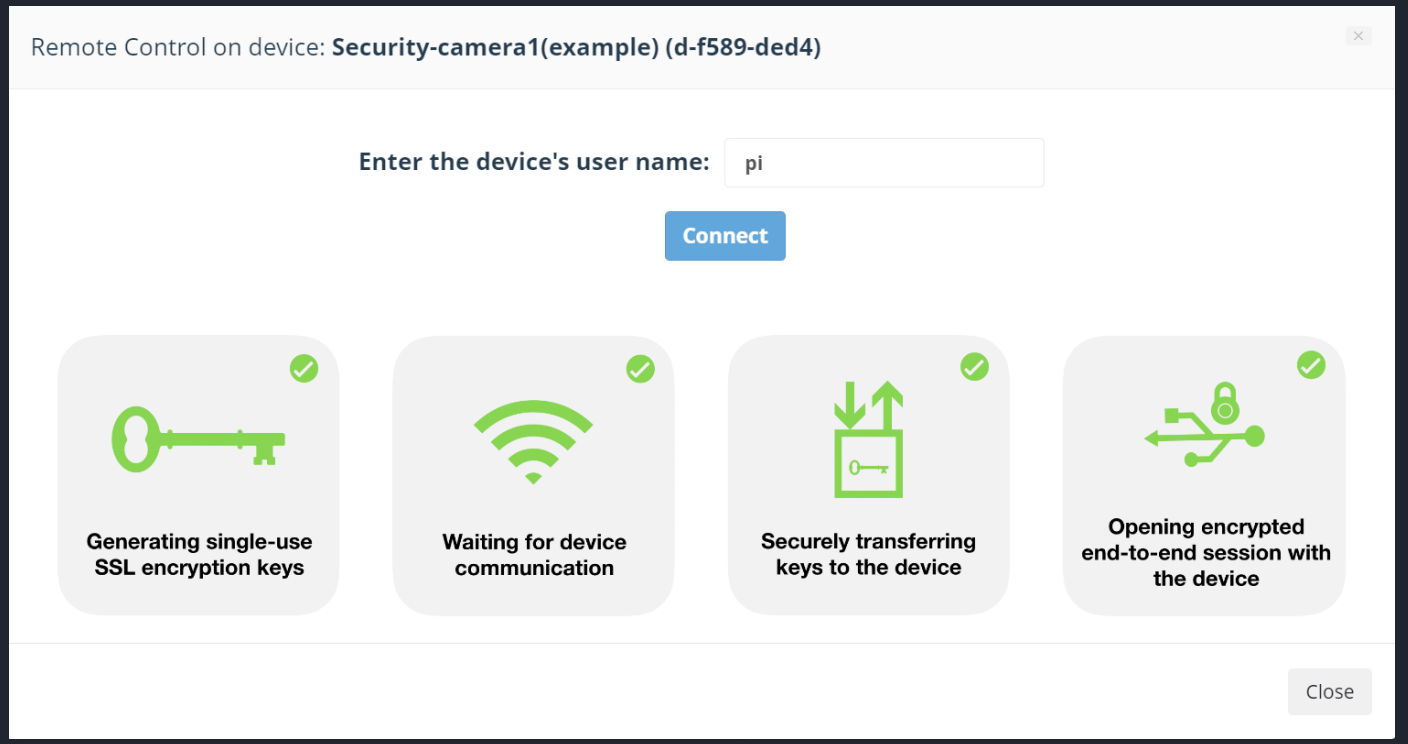
Production Benefits

- Designed to support complex network environments
  https://docs.connect.jfrog.io/overview/architecture/agent
    - No Public IP
    - Behind double-nat
    - Under a firewall, cellular modem
    - Unstable wifi connection
- Register devices at scale
  https://docs.connect.jfrog.io/register/register-linux-devices-at-scale
    - Option A: Insert Connect service into a build of an image
    - Option B: Freeze image

About the Reverse SSH Tunnel

- Normally, a tunnel is created from the device to Connect
- For remote control access, a tunnel is created within the original tunnel, back to the device
- No port numbers are forwarded
- No ports need to be open on the device or firewall for the remote access to work



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OTA Updates

Create an Update Flow

1. Navigate to **Updates** > **Create Update Flow**
2. Name the flow `Initial Files`
3. Drag the **Deploy Files** block into the flow and click the **pencil icon** to edit the block

   - Destination: /home/pi

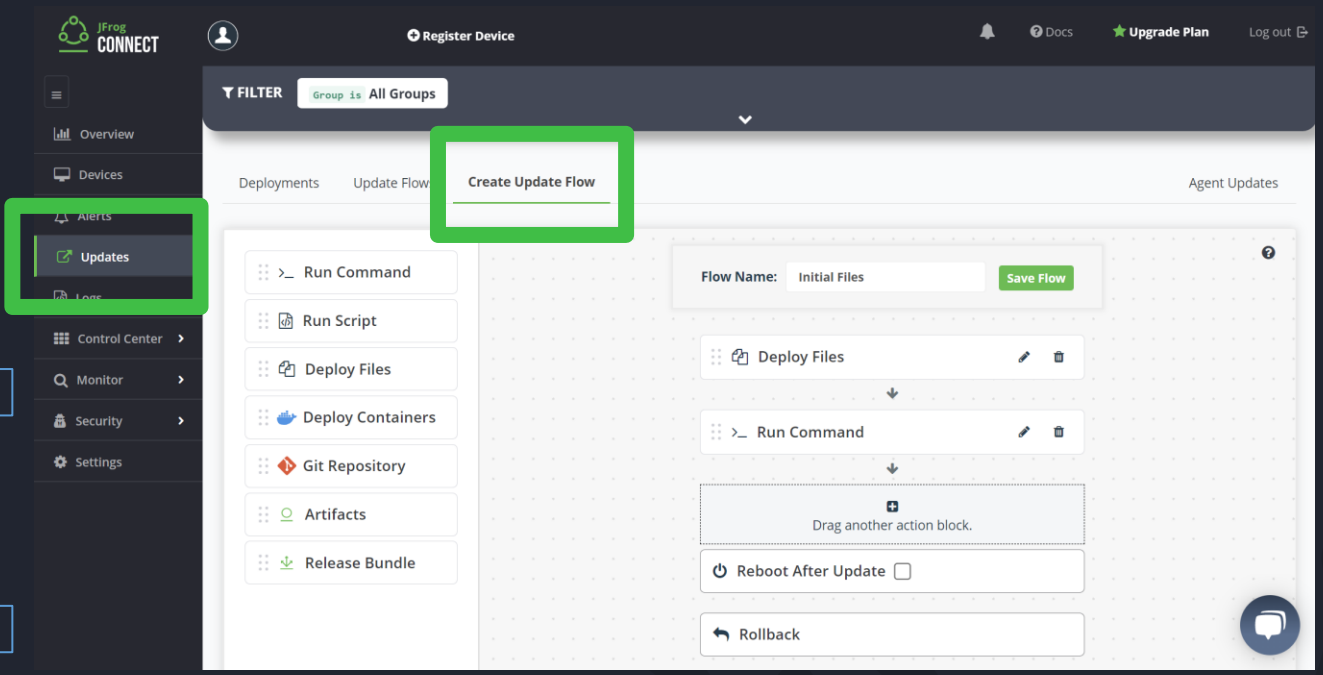
   - Sample project files are available here:

```
git clone https://github.com/NickR2600/ConnectDemo01.git
```

4. Drag in the **Run Command** block and edit by adding this command:

```
runuser -l pi -c 'make && ls' > /dev/tty1
```

5. Click **Save Flow**
6. When asked about the General Rollback, select **Continue Anyway**



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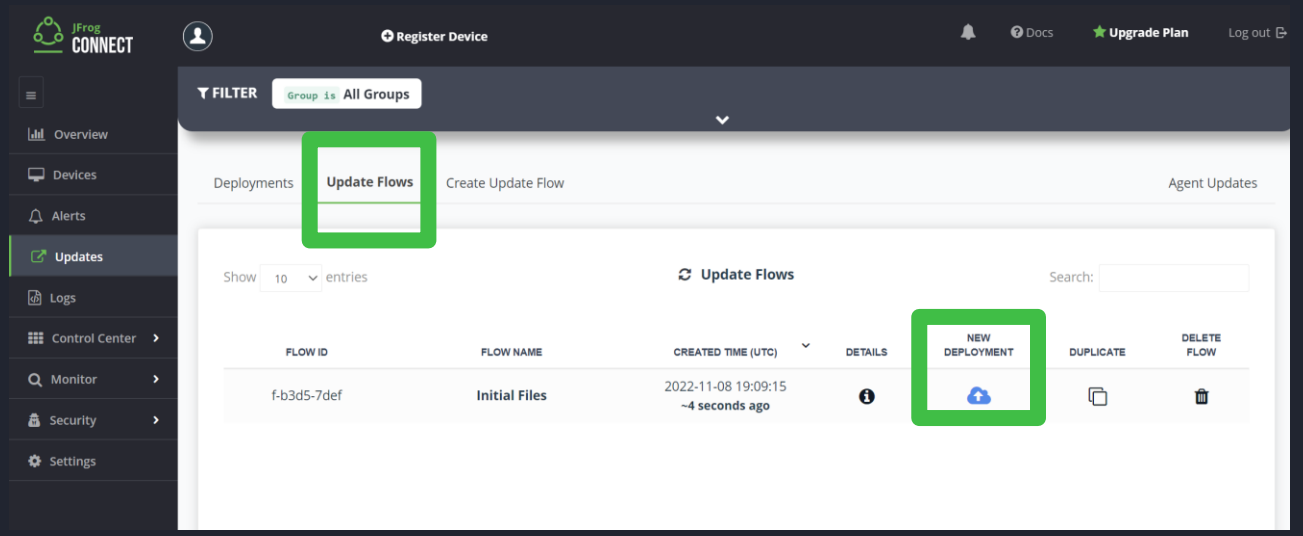
Deploy the Update Flow

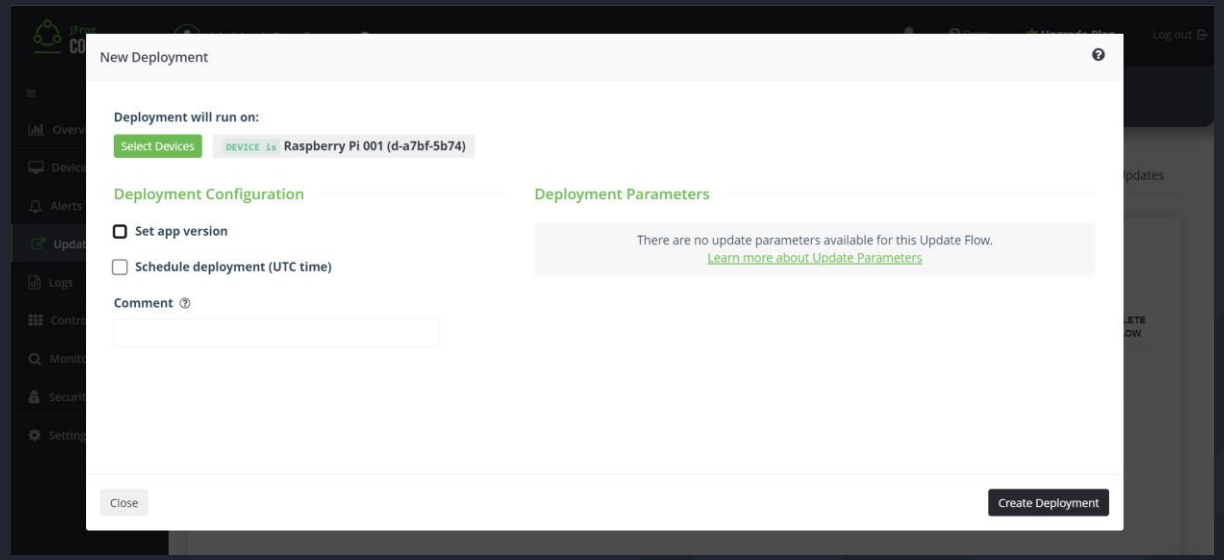
7. Navigate to **Updates** > **Update Flows**
8. Click the **New Deployment cloud icon** for the `Initial Files` update
9. Click the **Select Devices** button

    - Filter for, and select your specific device

    - Select **Apply**, **Next**, **Finish**

10. In this case, unselect **Set app version**
11. Click **Create Deployment** and run the deployment

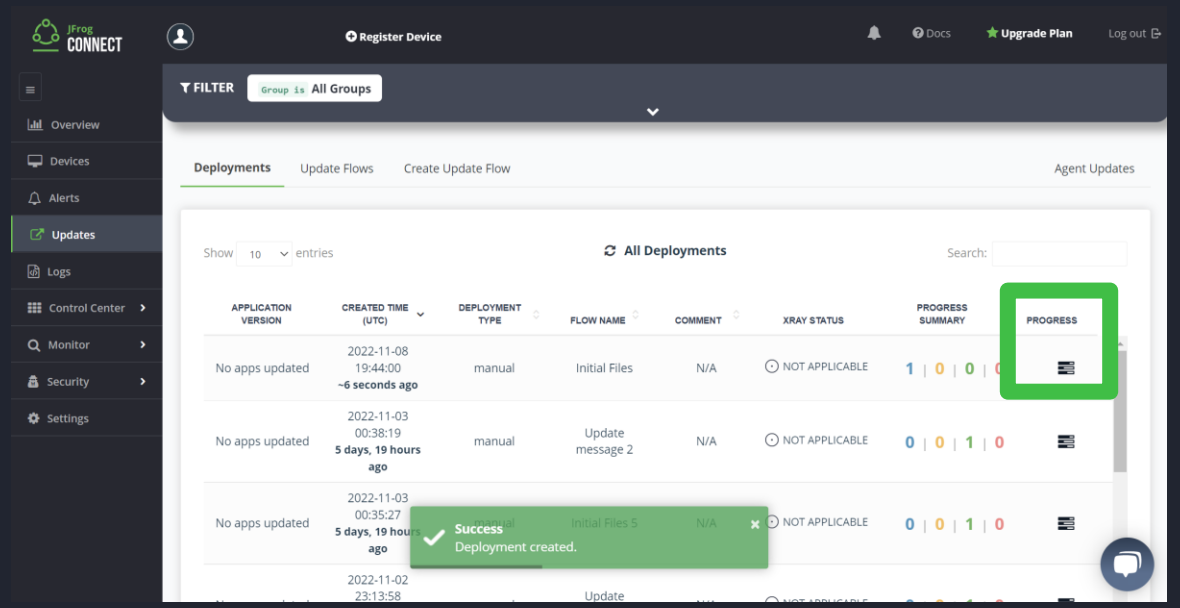


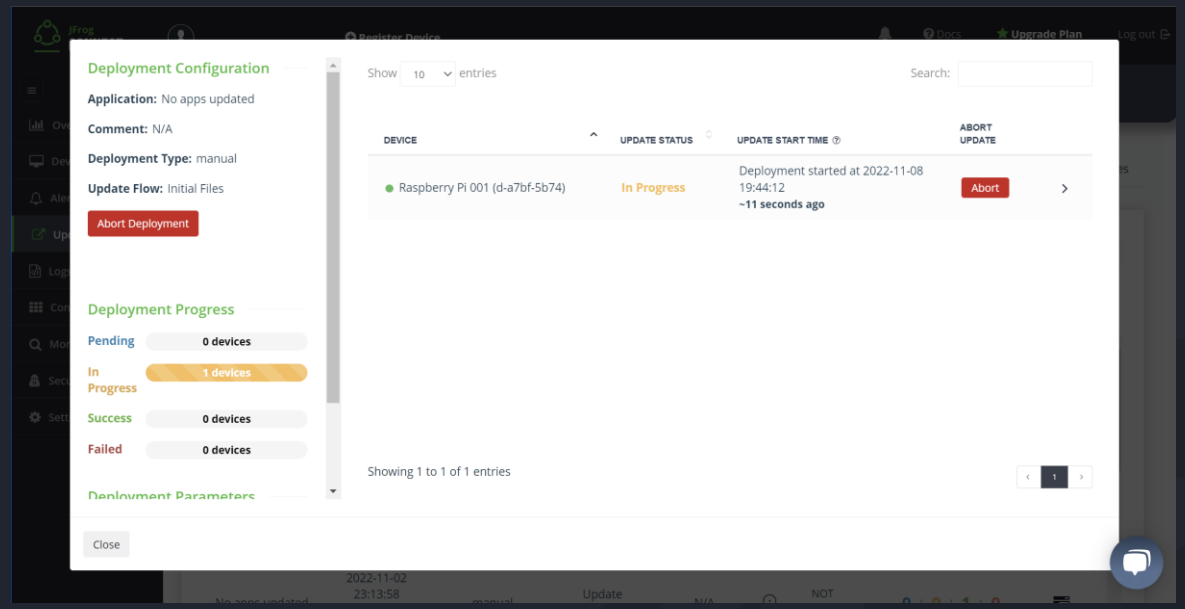


Observe the Update

12. Navigate to **Updates** > **Deployments**
13. For the update you just created, click the **progress** icon
14. Observe the progress in the dialog box and the monitor attached to your RPi
15. After the deployment succeeds, enter `./demo` on the keyboard connected to the RPi to run the program.

    - If you don't have a RPi, do this in a remote terminal for the device created by Connect



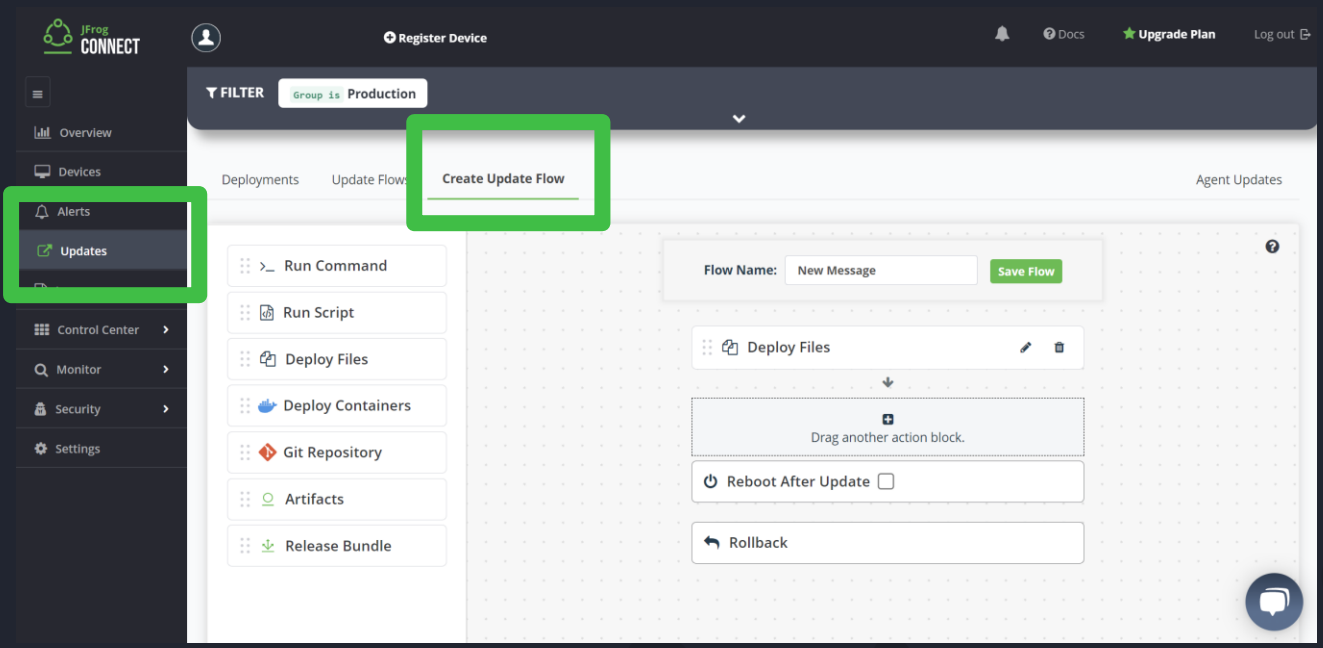


Notes about the Update

- Step 15 is necessary this time because this is a TTY program. Other programs, like those that drive a kiosk, can be started from step 4
- Other blocks exist to accommodate other actions, sources, and types:
    - Run a script
    - Deploy artifacts from Github
    - Deploy artifacts from Artifactory
    - Deploy a Docker Container
- Rollbacks prevent bad updates from bricking devices
    - Rollback to the previous stable state
    - Ability to specify actions when a particular step fail

Update the Message

1. Ensure the program is still running on the RPi
   - Ignore this if you don't have a RPi
2. Modify message.txt to read `Fixed` instead of `Buggy`
3. Navigate to **Updates** > **Create Update Flow**
4. Name the flow `New Message`
5. Drag the **Deploy Files** block into the flow and click the **pencil icon** to edit the block
   - Destination: /home/pi
   - Specify the updated message.txt
6. Click **Save Flow**
7. When asked about the General Rollback, select **Continue Anyway**



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Deploy the Update Flow

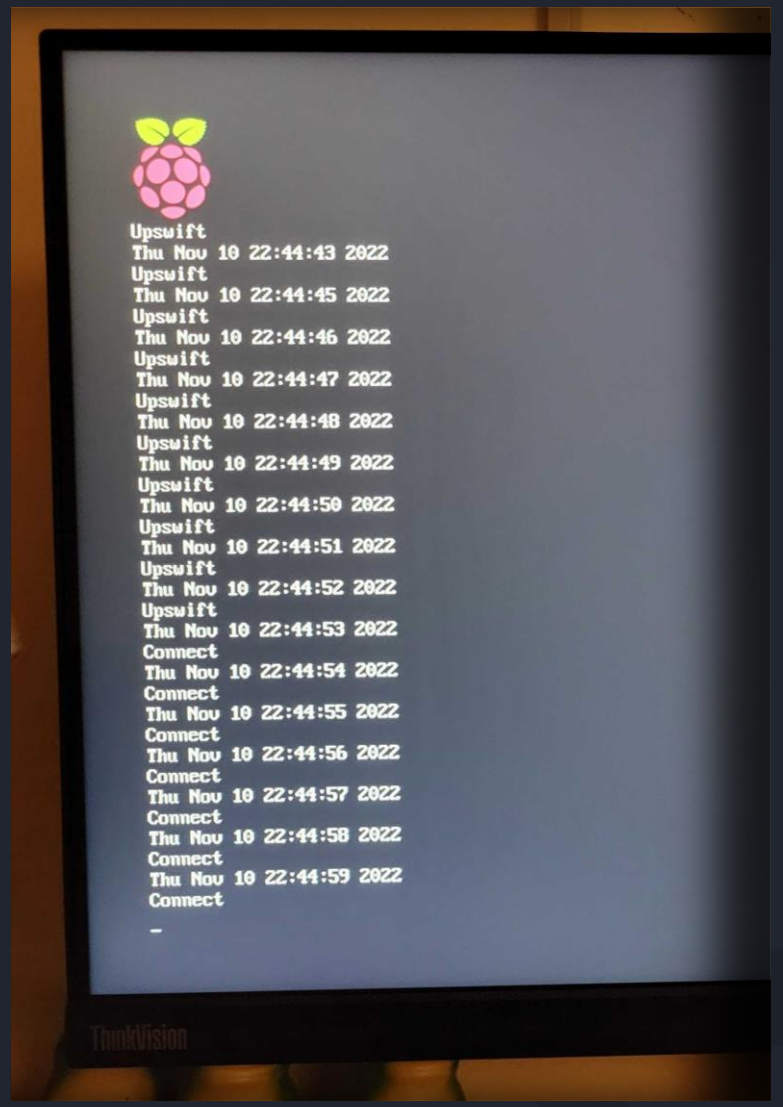
8. Navigate to **Updates** > **Update Flows**
9. Click the **New Deployment** cloud icon for the New Message update
10. Click the **Select Devices** button

    - Filter for, and select your specific device

    - Select **Apply**, **Next**, **Finish**

11. In this case, unselect **Set app version**
12. Click **Create Deployment** and run the deployment
13. Observe the new message in the running program!

    - If you don't have a RPi, open a remote terminal and observe the new output when you run `./demo` again



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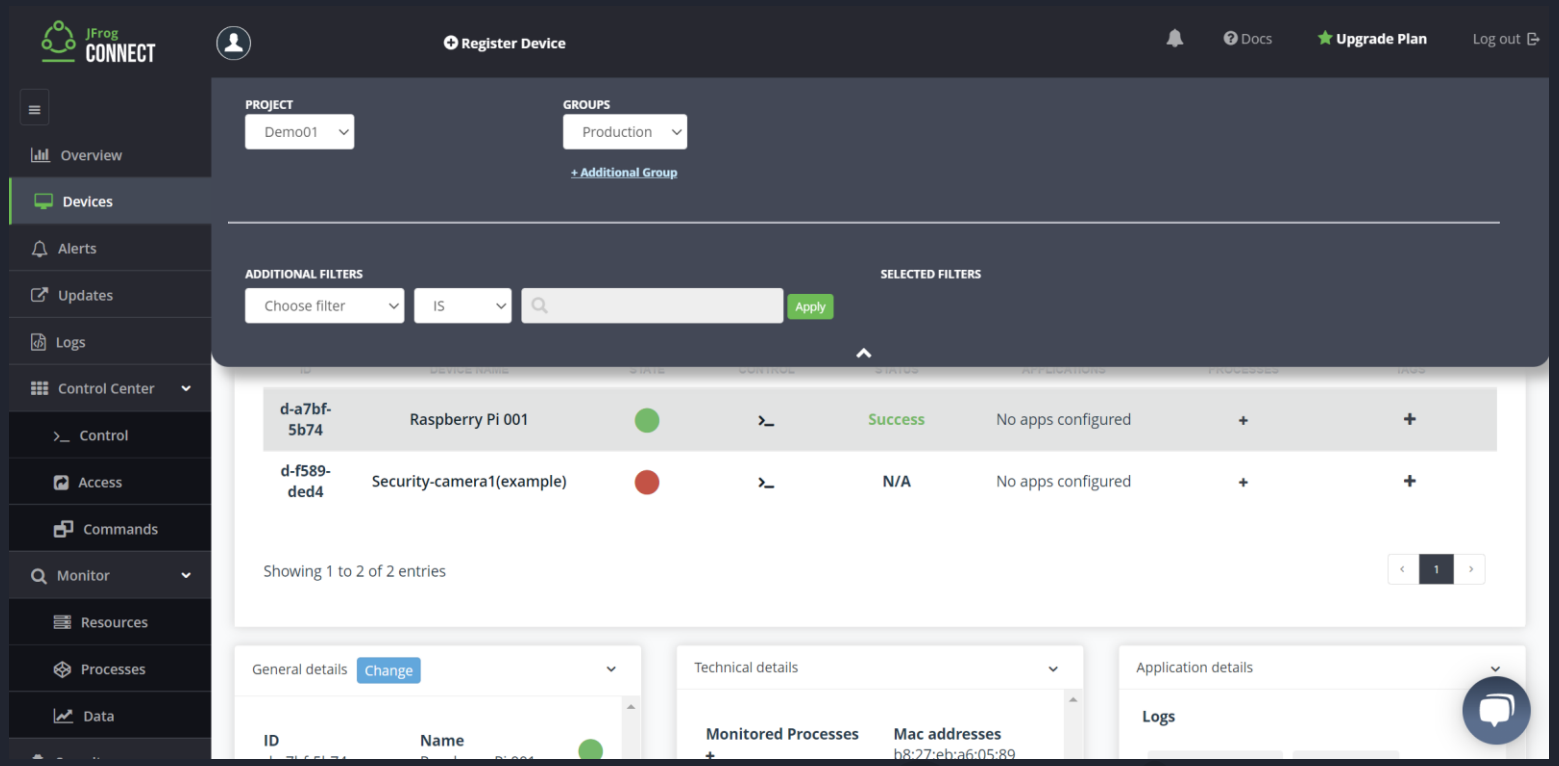
At Scale

Tips for Managing Devices at Scale

Filtering through devices:

- Use the **Filter Bar**
- Create groups
- Tag devices
- Create app/version numbers
  - When Deploying a Flow
  - In the Devices Tab



Recommendation:

- Get it right on one device before rolling out to entire fleet

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Things You May Not Have Noticed

- C++ is platform-dependent

  - We generated a device-specific binary (the executable)

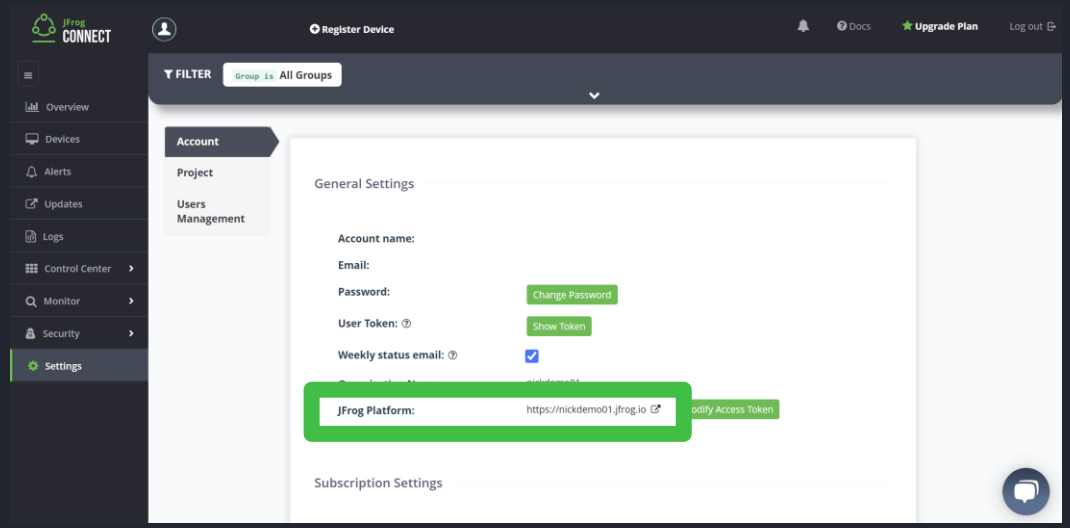
  - That binary and message.txt are all we need to push to devices

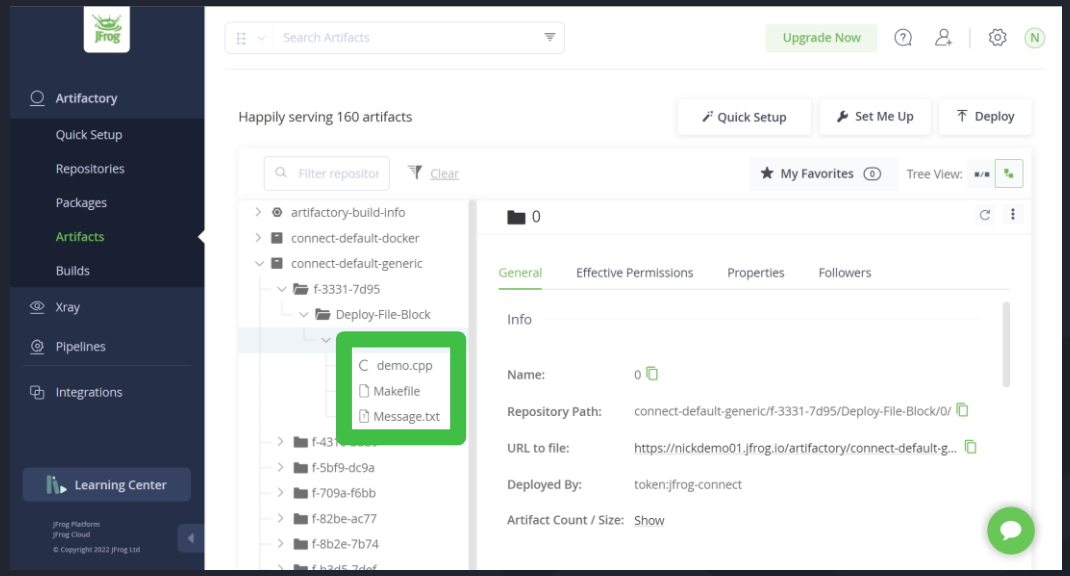
- A new Connect instance comes with a new instance of Artifactory

  - Files you upload via Connect are stored automatically in your Artifactory instance

  - Find your Artifactory/Jfrog Platform instance under the Connect **Settings** tab

  - You can specify another Artifactory instance in the Artifacts block of Create Update Flow





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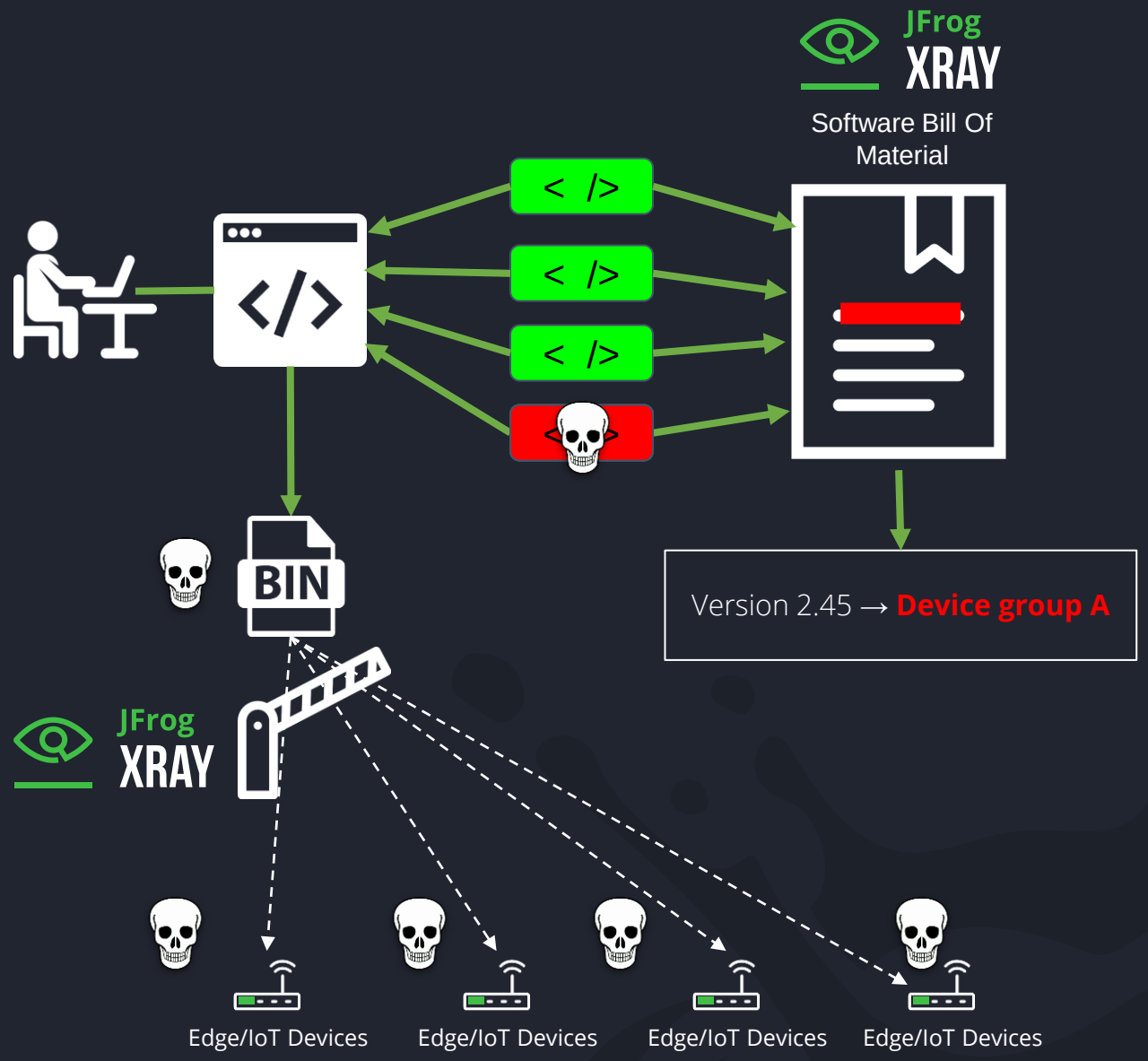
JFROG SOFTWARE SUPPLY CHAIN SECURITY

- All components of a release are scanned for vulnerabilities
- **JFrog Xray** policies prevent vulnerabilities from reaching production environment
- JFrog Xray **Software Bill of Material** provides visibility into which devices run versions with vulnerabilities



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SaaS or Self Hosted?

Cloud

- Azure, AWS, Google

On-Premises

- Coming soon

- Is it easier/cheaper for a cloud vendor to provide services you need?
- Are you allowed to have binaries leave your country's borders?
- Does the right vendor exist within your country?
- Do security concerns/laws outright disqualify any cloud provider?

JFrog
CONNECT

Thank you!

Nick Ristuccia
Developer Advocate at JFrog

https://jfrog.com/connect/

```
git clone https://github.com/NickR2600/ConnectDemo01.git
```