Arm Everywhere

(Almost) A Demo of an Arm Cloud, Edge, and IoT Infrastructure

Linaro connect
San Diego 2019

Goal: A complete global infrastructure, built entirely on Arm

Warning: This is a work in progress!

IoT Endpoints

Raspberry Pi

- Distributed across the globe
- Running Arm Mbed Linux OS
- Air Quality, Lightning Detection, GPS sensors
  - Feed data to the nearest Edge Node

Edge Nodes

96Boards / Linaro

- 96Boards devices in North America and India
- Collecting the data streams from the IoT Endpoints
- Packaging and sending the data to the Cloud Server

Cloud Server

Ampere eMag, hosted by Packet

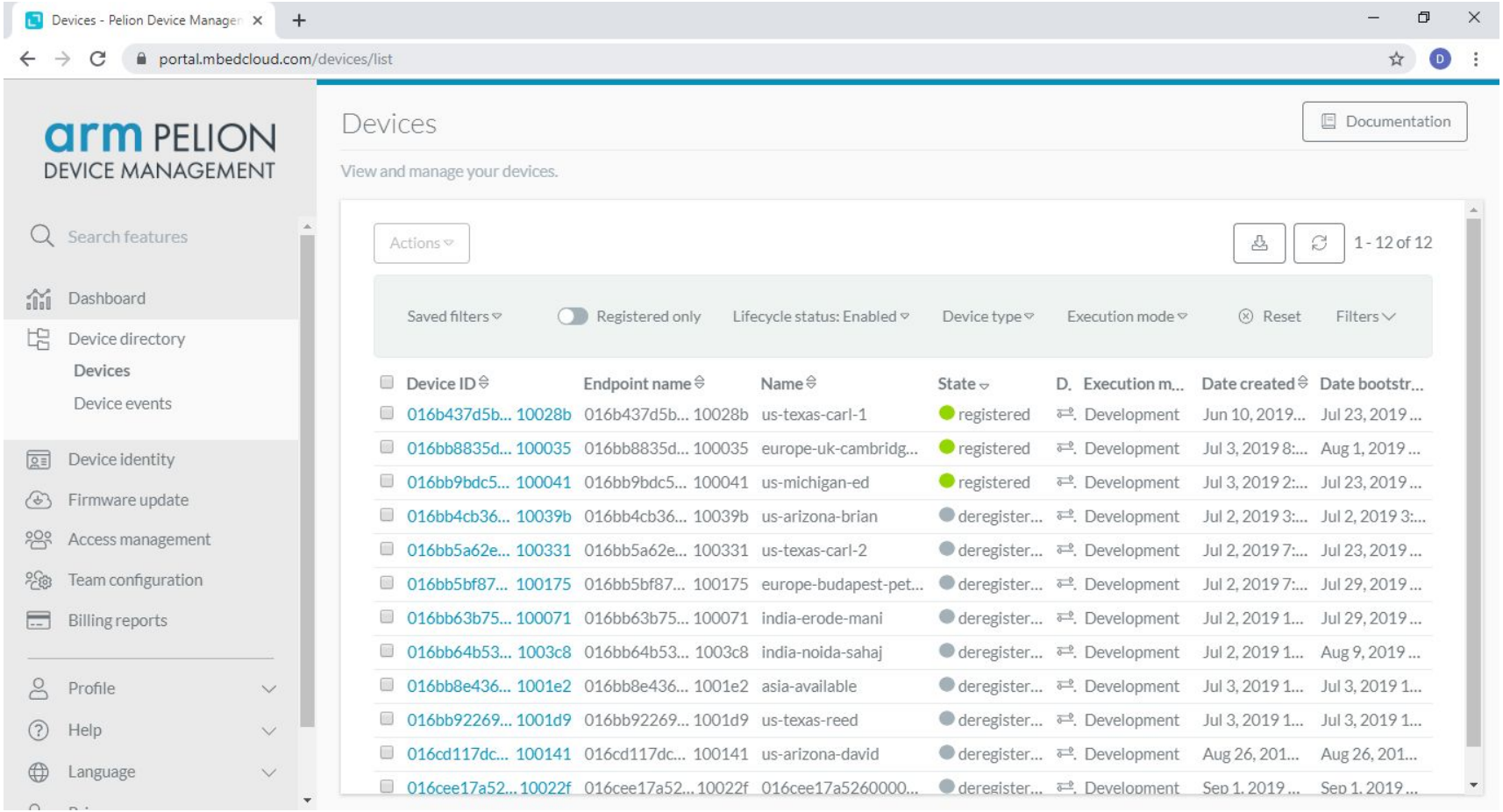
- Bare metal Arm Server
- Collecting the packaged data from the Edge Nodes
- Storing the data and running visualization dashboard

IoT Endpoints

Mbed Linux OS, Pelion Device Management

Arm Mbed Linux OS is a secure and stable platform for IoT devices, that runs a container engine.

- Allows for remote deployments of containers, for application installs and updates
- Allows for secure and safe operating system upgrades
- Has a central, web-based interface that shows connected (and offline) devices
    - Security and certificate management
    - Push containers to devices
    - Register and deregister devices


Devices - Pelion Device Manager
portal.mbedcloud.com/devices/list
arm PELION
DEVICE MANAGEMENT
Search features
Dashboard
Device directory
Devices
Device events
Device identity
Firmware update
Access management
Team configuration
Billing reports
Profile
Help
Language
Devices
Documentation
View and manage your devices.
Actions
1 - 12 of 12
Saved filters
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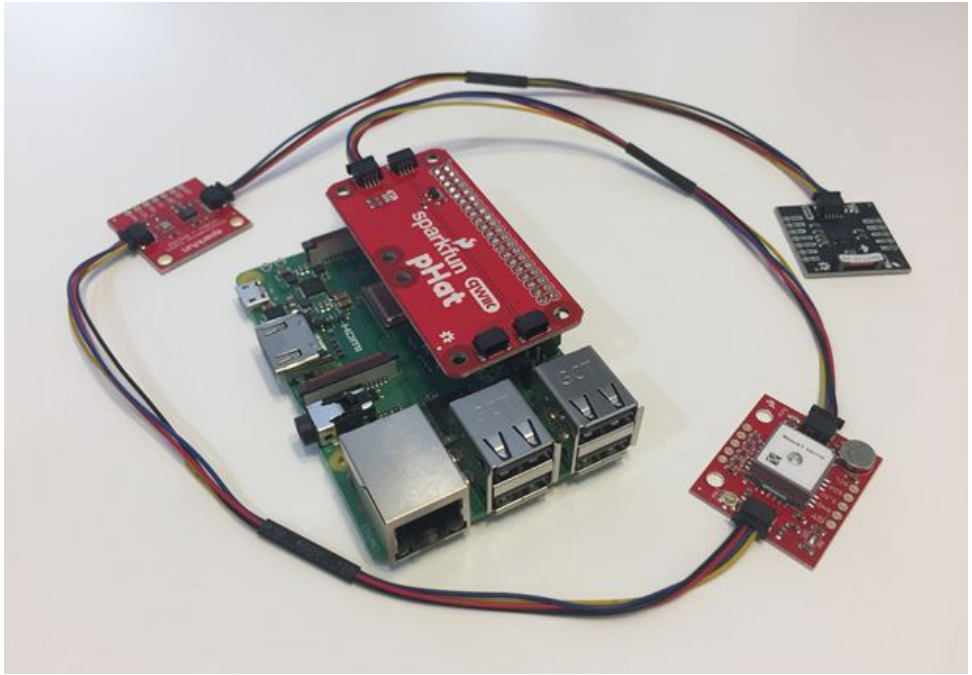
016cee17a52... 10022f 016cee17a52... 10022f 016cee17a5260000... deregister... Development Sep 1, 2019 ... Sep 1, 2019 ...

IoT Endpoint Ready for Deployment

Raspberry Pi 3B+

- SparkFun Qwiic pHat
- SparkFun GPS, Air Quality, and Lightning Detection sensors
- Many other sensor options exist as well



Currently Deployed Devices

Data Currently Being Captured

Customizable based on sensor selection. This demo uses:

- Temperature
- Humidity
- Barometric Pressure
- Total Volatile Organic Compounds (TVOC)
- Equivalent CO2
- Lightning Strikes
- GPS Coordinates / Location

Optional Sensors Include:

- Infrared
- UV Light
- Human Presence Detection
- Distance Measurement
- RFID Scanning
- Interfaces such as knobs, buttons, swipe gestures
- Relay and motor control

Potential Use Cases

- Sustainability Initiatives
- Environmental Monitoring
- Manufacturing / Factory
- Hospital / Medical Facility
- Retail
- Energy Sector
- Smart Cities
- Agriculture

Example Use Case

United States
Nevada
Utah
Colorado
Kansas
Nebraska
California
Arizona
New Mexico
Oklahoma
Texas
Salt Lake City
Denver
Colorado Springs
Kansas City
Wichita
Omaha
Lincoln
Sacramento
San Jose
Fresno
Bakersfield
Las Vegas
Albuquerque
Phoenix
Tucson
Oklahoma City
Tulsa
Dallas
Fort Worth
Plano
Austin
San Antonio
Houston
Los Angeles
South Valley
Long Beach
San Diego
Tijuana
Ensenada
Mexicali
Ciudad Juarez
Chihuahua
Municipality
Monterrey
0
1,000
km

Smokehouse wildfire controlled near Wittman; Jomax fire nears full containment

Rocky Baier, Arizona Republic

9-12 minutes

Brush fire burns near Cave Creek Road

A brushfire erupted Sunday afternoon, July 7, 2019, in north Phoenix, closing streets from Cave Creek Road to Jomax Road and Tatum Road as fire crews from multiple agencies worked on the scene. *Madeleine Cook/The Republic*

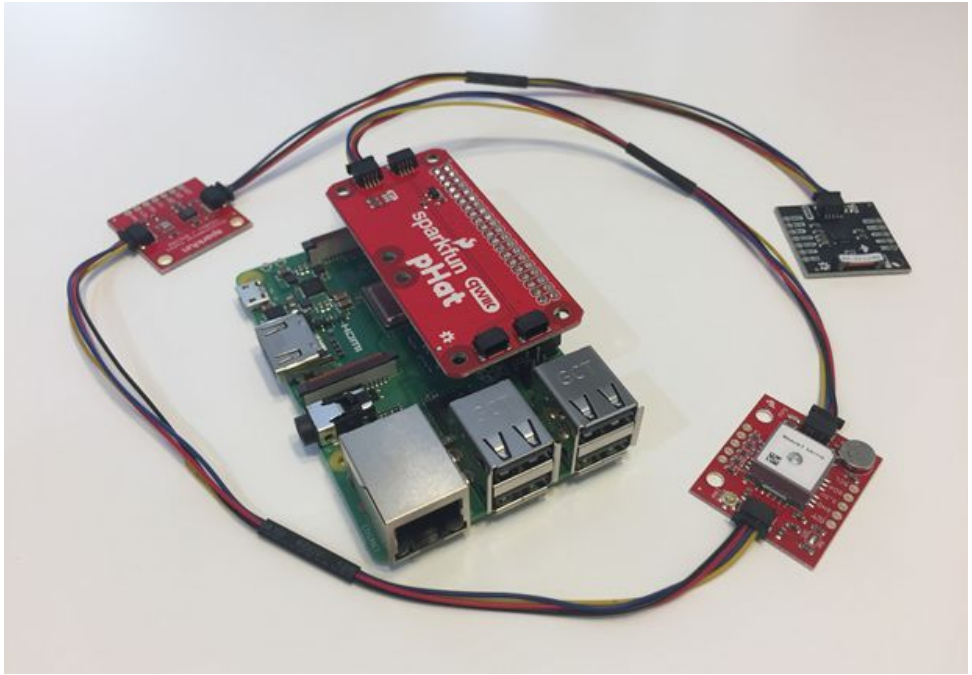
In the deserts of Arizona and the western United States, lightning sparks devastating wildfires.

Rapid detection is critical to contain the fires, in turn saving lives, wildlife, and dollars.

Let’s Revisit the IoT Endpoint

Raspberry Pi 3B+

- Lightning Detection
- Air Quality: CO2 and Particulates
- GPS



Current Status

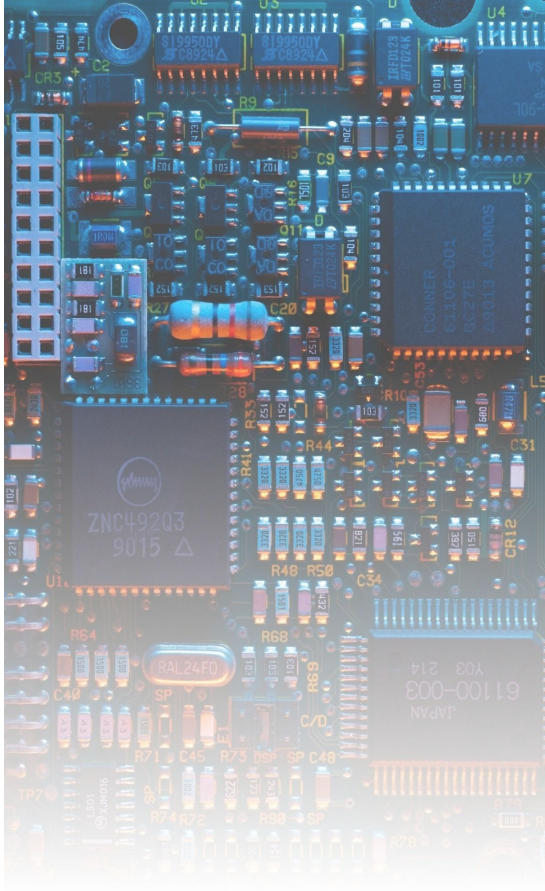
IoT Endpoints

Working:

- Container creation is well understood, and Alpine / Python container base is built.
- Passing GPS and Air Quality sensor hardware from the Host OS to the container is resolved.
- Storing data locally.
- Deployment steps to provision a node and push a container to a node via Mbed Tools and Mbed CLI

Not Working:

- Communicating via MQTT to the outside world, from within the container.
- Lightning detection sensor is not available within a container yet.
- Data flowing up to Edge nodes or Server



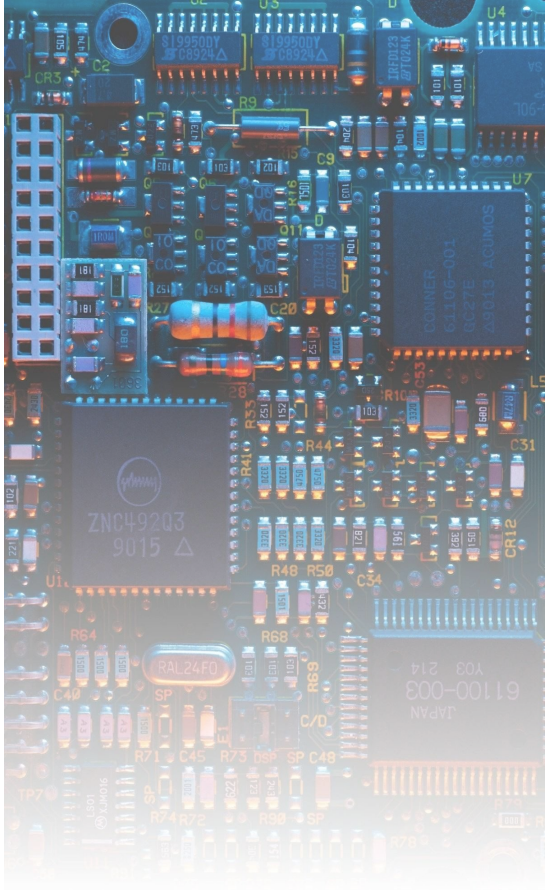
Edge Node, Cloud Server

Working:

- Edge Nodes are provisioned and running.
- Server is deployed at Packet, InfluxDB installed, and Grafana dashboard installed and accessible via internet.

Not Working:

- Valid data flowing through the system.



Lessons Learned

Mbed Linux OS

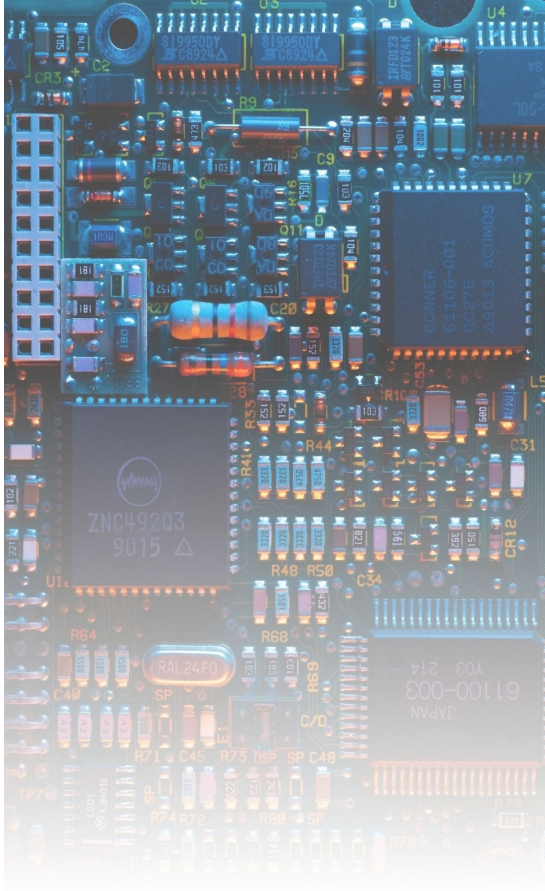
Development has been much slower than anticipated:

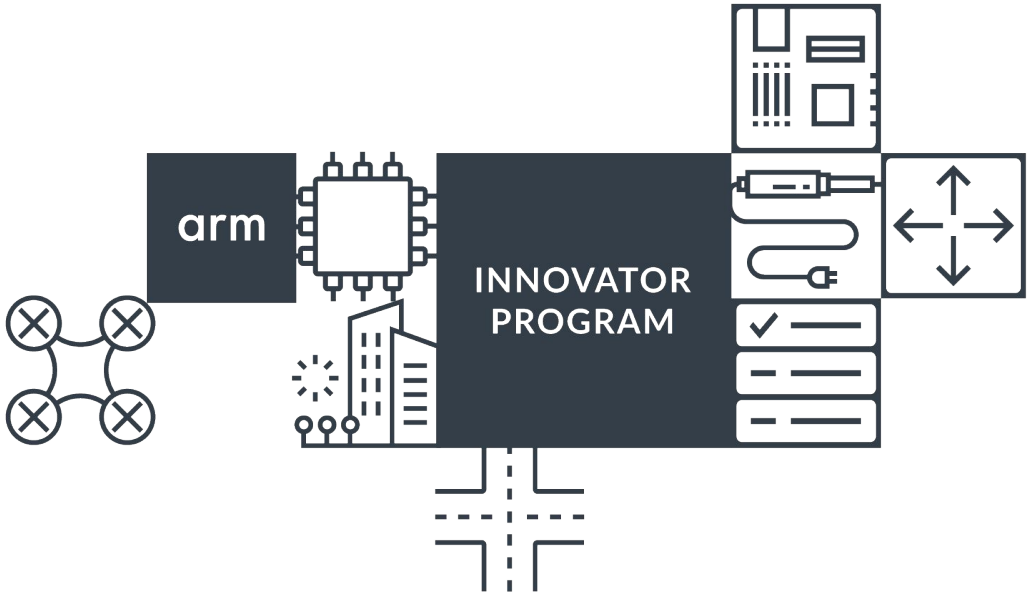
- Embedded linux is much different than “regular” linux distributions.
  - No package management
  - Every change requires rebuilding, reflashing SD Card, re-pushing container, retesting, troubleshooting, and starting over.
- Mbed Linux did not have I2C enabled. Porting from Raspbian took weeks, just to enable reading data from the sensors.
- Mbed Linux is in beta. As a result, documentation is thin, and there are no example projects to draw knowledge from.
- Opencontainer Runtime (runc) is much less documented than Docker. Few examples for hardware passthrough.

Ecosystem Challenges

Development has been much slower than anticipated:

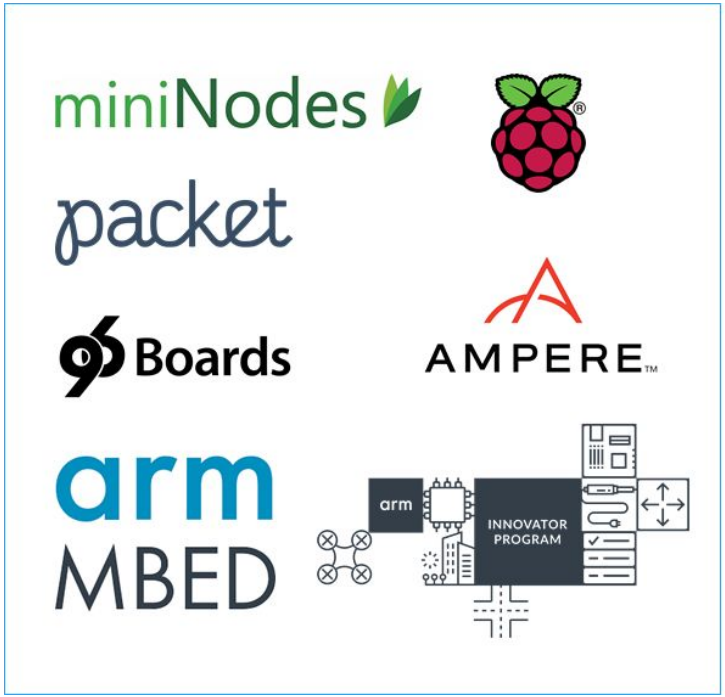
- No “standards compliant” Arm Desktop PC exists.
- Cross-architecture builds are difficult, even within Arm
  - 64-bit Armv8 Host, 32-bit Armv7 target
- Mbed Linux is using OCI, as opposed to Docker
  - Dockerfile versus config.json (far fewer examples)
  - No system to pull down images from a Docker Hub
- Had to use a Raspberry Pi to do development work
  - docker pull alpine
  - docker export alpine > rootfs.tar
  - (manually copy / paste files to Mbed Linux board)
  - runc run alpine





Fun Fact:

Most of our work has been done on Windows on Arm powered laptops, courtesy of the **Arm Innovator Program**!



Questions
(and hopefully Answers!)

...And let's continue the discussion, as well!

Thank you

Join Linaro to accelerate deployment of your Arm-based solutions through collaboration

contactus@linaro.org

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