IOT Project Framework

Needs and Resulting Architecture

Introduction

- Share our project start experience to help end of year project
- Discuss design choices, SW, and HW decisions
- Evaluate ultimate decisions and experiences
- Share new devices and discuss project potentials
- Give ideas and inspiration for some creative projects

My Project Needs

- Automation to care for plants remotely
  - Travel constantly, leave skiing on weekend
  - No one is around to care for the plants

- System Needs
  - System to access anywhere in world
  - See, sense environment, and care for plants
  - Scalable, reliable, easy to use, easy to repair
  - Dozens of sensors required
  - Capabilities to enable a commercial offering

Initial Product Thoughts

- Simple Phone App

- Light control

- Moisture sensors

- Temperature, CO2, humidity, lumens

- Pump Controls watering/fertilizing

- Cameras

- Soil PH

- Support dozens of sensors and controllers (100's commercially)

- Multiples of each

- Low touch easy install

- Easy to diagnose and repair

- Send alerts
  - Email/SMS

Decisions to make

- Component Selection

- Processor selection

- SW Selection

- Technology to connect all devices

- Device topology

- Network topology and connections

- App environment

Component Selection

- Very low cost devices

- Commodity devices that draw limited power

- UL listed safe devices to avoid issues

- Ethernet enabled

    – Device scale, easy integration, securable

    – Readily available on low cost device

Processor/SW Selection

- Two classes of processor needed

  - Simple sensor controller integration (sensors/controllers)

    - Minimize cost of entire solution

    - GPIO control is pretty simple operation

  - Complex service oriented needs

    - PI Broker, camera services, other complex devices

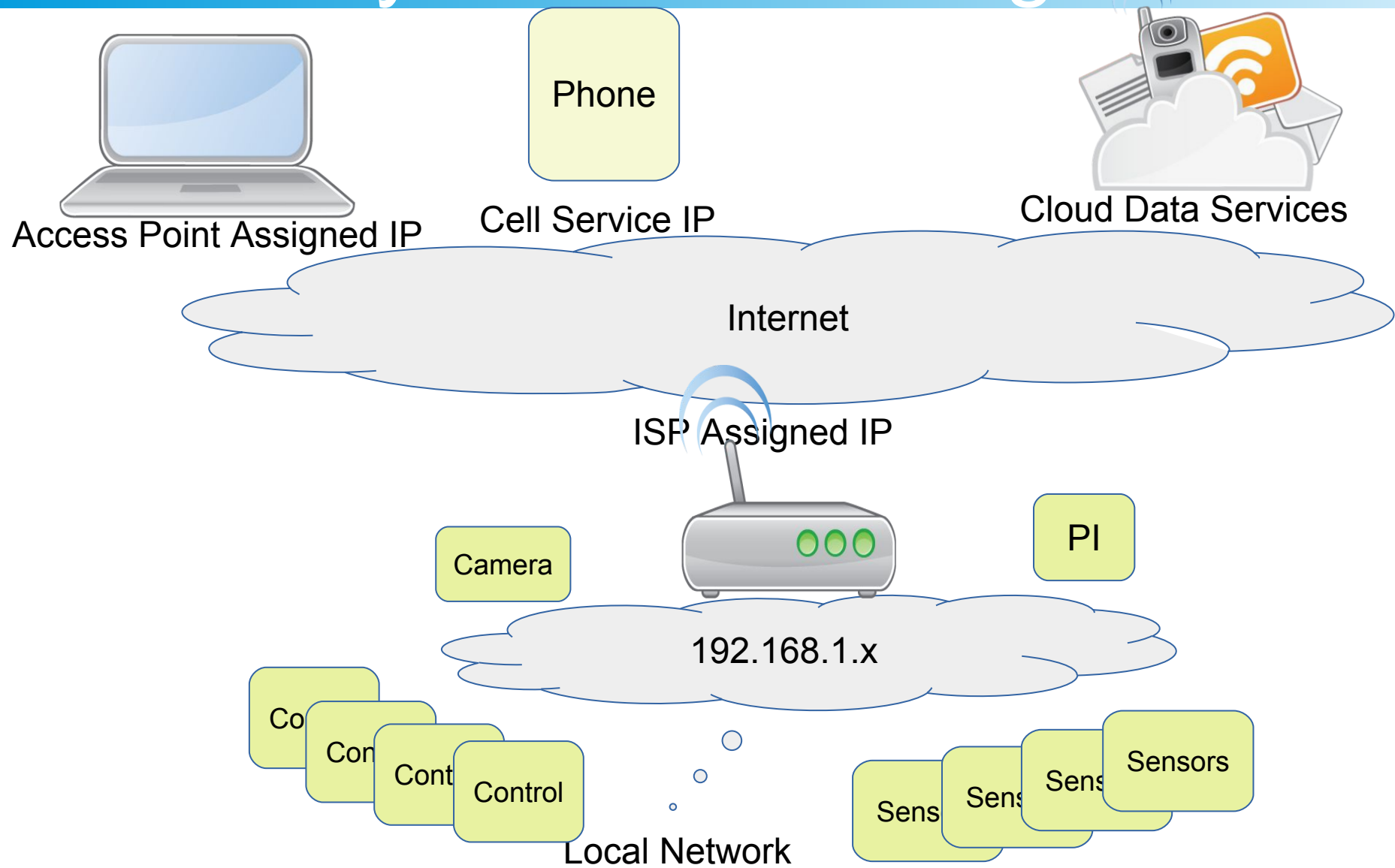   - Want to leverage Open Source SW available
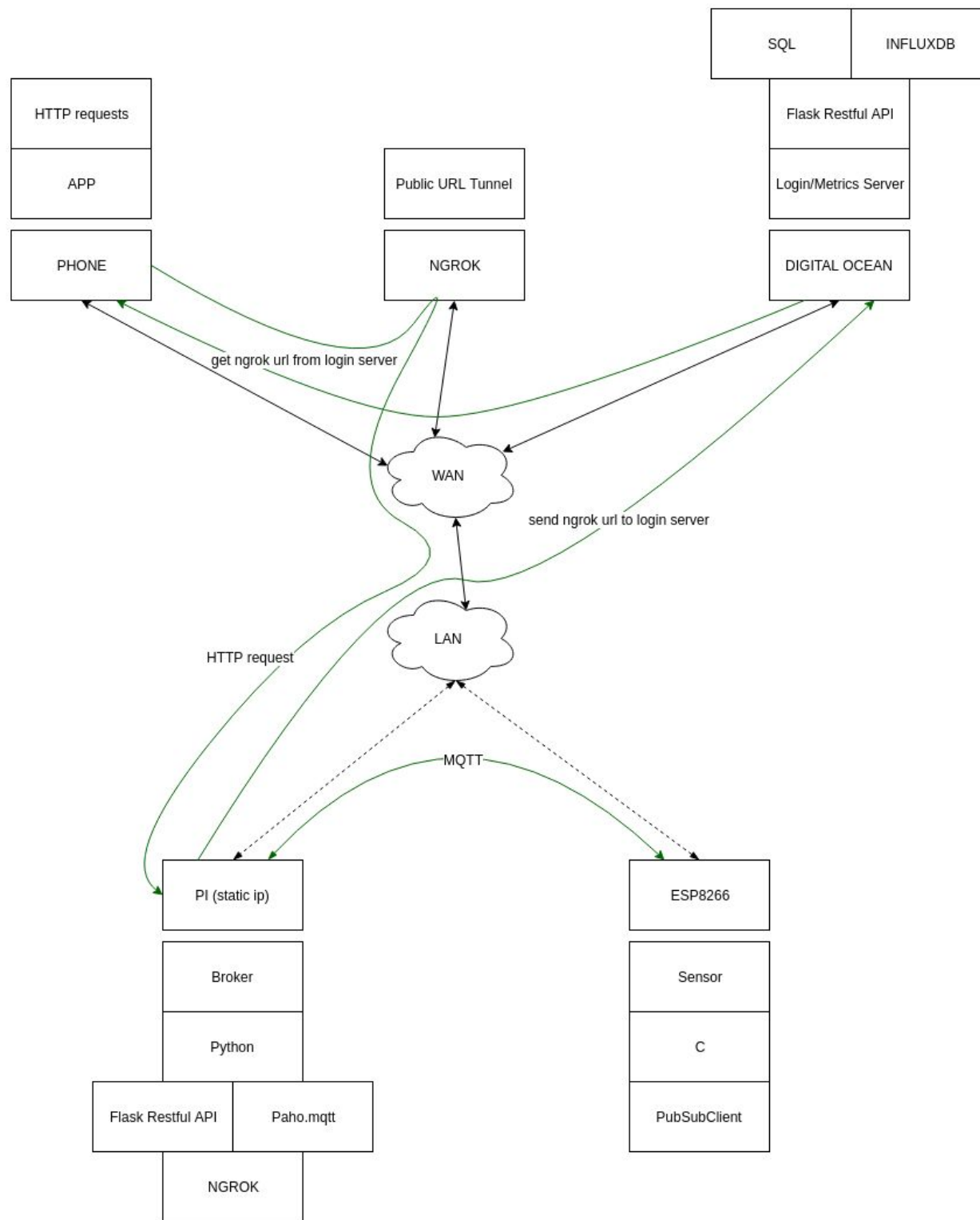
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Device Topology and Connection

- Needs to scale to 100's of devices

- Hot insert and remove

- Support in commodity SW and HW

- Needed to span 100's of square feet

- Secure and reliable

- Cost effective

Answer? - Ethernet

System Block Diagram

Phone

Cell Service IP

Cloud Data Services

Access Point Assigned IP

Internet

ISP Assigned IP

Camera

PI

192.168.1.x

Control
Control
Control
Control

Sensors
Sensors
Sensors
Sensors

Local Network

Device Connection Strategy

- **Simple Configuration**

  - DHCP assigns all local devices

  - PI static 192.168.1.2

  - Devices register w/PI

  - Mac address is UID

  - Broker uses UID for pub/sub

  - Ques constant thru restart/power cycles

- **Issues Encountered**

  - 192.168.1.2 set in router

  - Persistent messages wreaked havoc

  - Have a more complex PI and device config, but not worth it now

  - Only have to port forward PI

  - Non static IP's

PI Broker Operation

- Subscribe to PI device namespace

- Set up device type node map on msg receipt

- Persist that node map

- Enable Restful server

- Start system services

- System Services
  - Light management
  - Pump Management
  - Sensor alert
  - Camera services
  - API services
  - Metric collection

All internet access in through the restful server

Sensor Show and Tell

- PI Zero, camera
- Cell phone devices
- Wheat Stone Bridge
- Thermal imager
- Amazon Dash Button
- Amazon Alexa's
- ZWave controller
- Stepper motors
- Moisture Sensors
- Temperature
- Humidity

- GPS
- Motion Sensor
- Long range radio
- Short range radio
- Finger print scanner
- Door locks
- Light beam interrupt sensors
- Biometric scanners
- Touch screen
- Ton of GPIO sensors/actuators
- Your imagination!!

Brainstorming Ideas

Class Discussion