Asset Tracking at Scale using BLE

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Asset Tracking at Scale Using BLE

Webinar

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Our Speaker

Justin Rigling

- Rigado co-founder and CTO
- Former design engineer at Garmin International
- Specializes in low-power wireless systems
- Holds a B.S. in Electrical Engineering from MIT
- Bluetooth SIG Associate Member

Rigado co-founder and CTO

Topics

- About Rigado & our BLE perspective (briefly)
- Why is **Asset Tracking** exciting?
- Why is Asset Tracking **with BLE** exciting?
- How are customers leveraging BLE for Asset Tracking **using Rigado**?
- What are we learning about BLE Asset Tracking **at scale**?

Our **Focus**

Rigado provides **solutions for edge connectivity & computing**

to teams delivering **large-scale Commercial IoT applications**

enabling them to **reduce complexity, cost & risk**

About **Rigado**

Experts in large-scale, enterprise Bluetooth

Working with innovative IoT teams since 2010, Rigado BLE gateway and module solutions now power more than 5 million connected devices.

Trusted by global brands for secure solutions

Rigado gateways are deployed in over 30,000 locations worldwide, in verticals such as Logistics, Hospitality, Smart Office and Healthcare.

Saving time, cost & risk for IoT teams

Solutions providers and systems integrators rely on Rigado for a secure and scalable edge infrastructure on which to deploy & manage their applications.

Smart Buildings & Lighting

Steelcase · DECO digital · TCI LED professional led applications · SORAA Simply Perfect Light™ · FAGERHULT

Location & Asset Tracking

NOVUS INOVA · CORE · PARABIT Enhancing Self-Service & Improving Security · Radius Networks

Sensing & Monitoring

TANDEM DIABETES CARE · ICON · concrete sensors · Oceasoft · ONSET

Solution Partners

NXP · NORDIC SEMICONDUCTOR · Core · AWS Greengrass · Microsoft Azure IoT Platform

Why is **Asset Tracking** Exciting?

Long-standing Asset-Tracking use-cases

- **Locating important things when you need them**
  - Healthcare – wheelchairs, oxygen tanks
  - Warehouses – fork-lifts, equipment
  - …
- **Knowing how much of something you have**
  - Retail – inventory management
  - Manufacturing – tracking supplies and replenishment
  - …

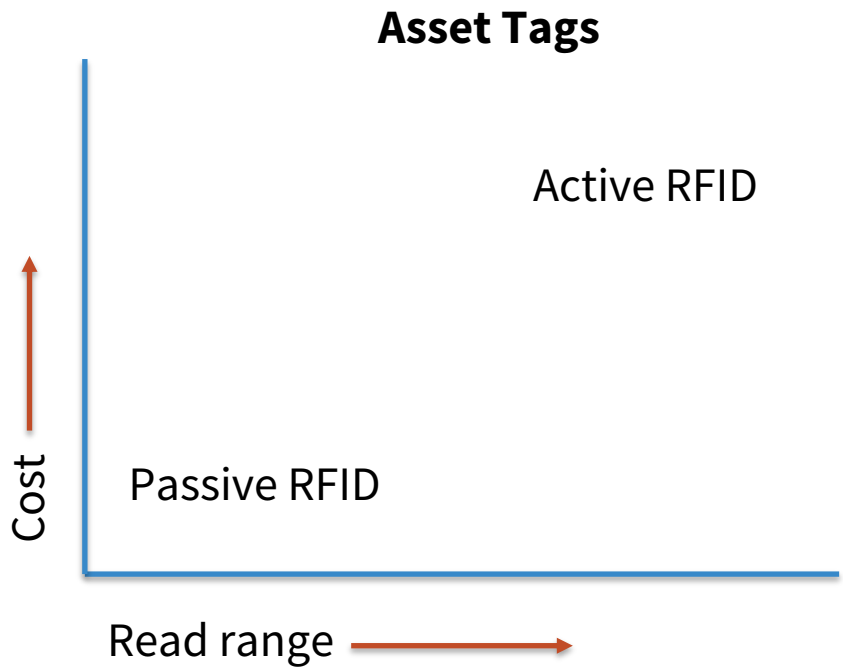
… as well as some new, emerging ones

- **Understanding traffic & utilization patterns**
  - Anticipating ‘peak times’
  - Improving resource allocation
  - …
- **Using machine learning to optimize asset management**
  - Finding non-obvious relationships & patterns
  - Applying algorithms to distributed, real-time decisions

Why is Asset Tracking **with BLE** exciting?

Traditional Asset Tracking approaches

- Passive RFID
  - Low cost
  - Limited read range
  - UHF
- Active RFID
  - Longer read range
  - UHF



BLE growing quickly in Location Services

Location Services

The broadcast topology available on Bluetooth LE enables one-to-many (1:m) device communications, is optimized for localized information sharing, and is ideally suited for enabling beacon-based location services found in the Smart Building, Smart Industry, Smart Home, and Smart City markets.

** source: Bluetooth.com (Bluetooth SIG)*

Location Services Use Cases

Point of Interest Information

Retailers adopted point-of-interest (PoI) beacons early, but Smart Cities are now discovering many ways PoI beacons can improve the quality of life for citizens and enhance the visitor experience. For example, PoI beacons are being broadly deployed within museums as well as along city walking tours.

Indoor Navigation

Bluetooth beacon-based indoor navigation and way finding solutions have quickly become the standard way to overcome the indoor coverage challenges of GPS-based approaches. Bluetooth based solutions are now commonly found with major venues including airports, train stations, as well as stadiums around the world.

Asset and Item Tracking

Bluetooth beacons power the rapidly growing asset tracking and item finding markets. Inexpensive item-tracking solutions help you to locate almost any possession. And large scale Bluetooth asset tracking solutions are being used by hospitals to track patients and expensive mobile equipment.

Space Utilization

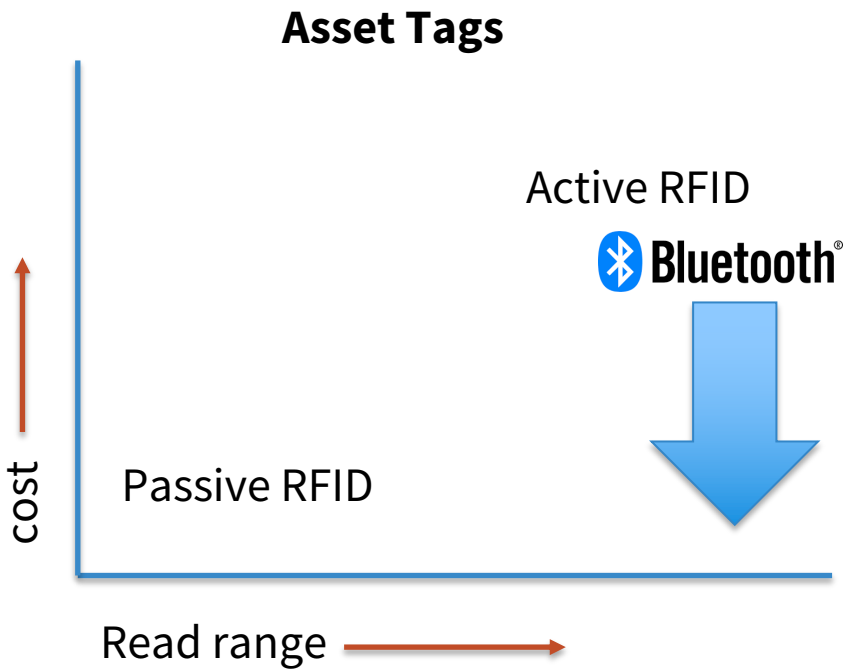
Bluetooth beacon solution are being deployed within office buildings, airports, exhibition centers, and even on city streets around the world to enable building owners and city planners to better understand how locations are being utilized. Bluetooth based space utilization systems can dramatically increase productivity, lower costs, and improve the lives of employees and citizens.

Advantages of BLE for Asset Tracking

- Better support for Sensors of all types
- Bi-directional communications
  - Configure sensors, update firmware
- Security
- Mobile (phones, tablets) can participate
- BLE has long range
  - Infrastructure is cheaper AND you need less of it.
- 2.4GHz band is global, unlike 900 MHz

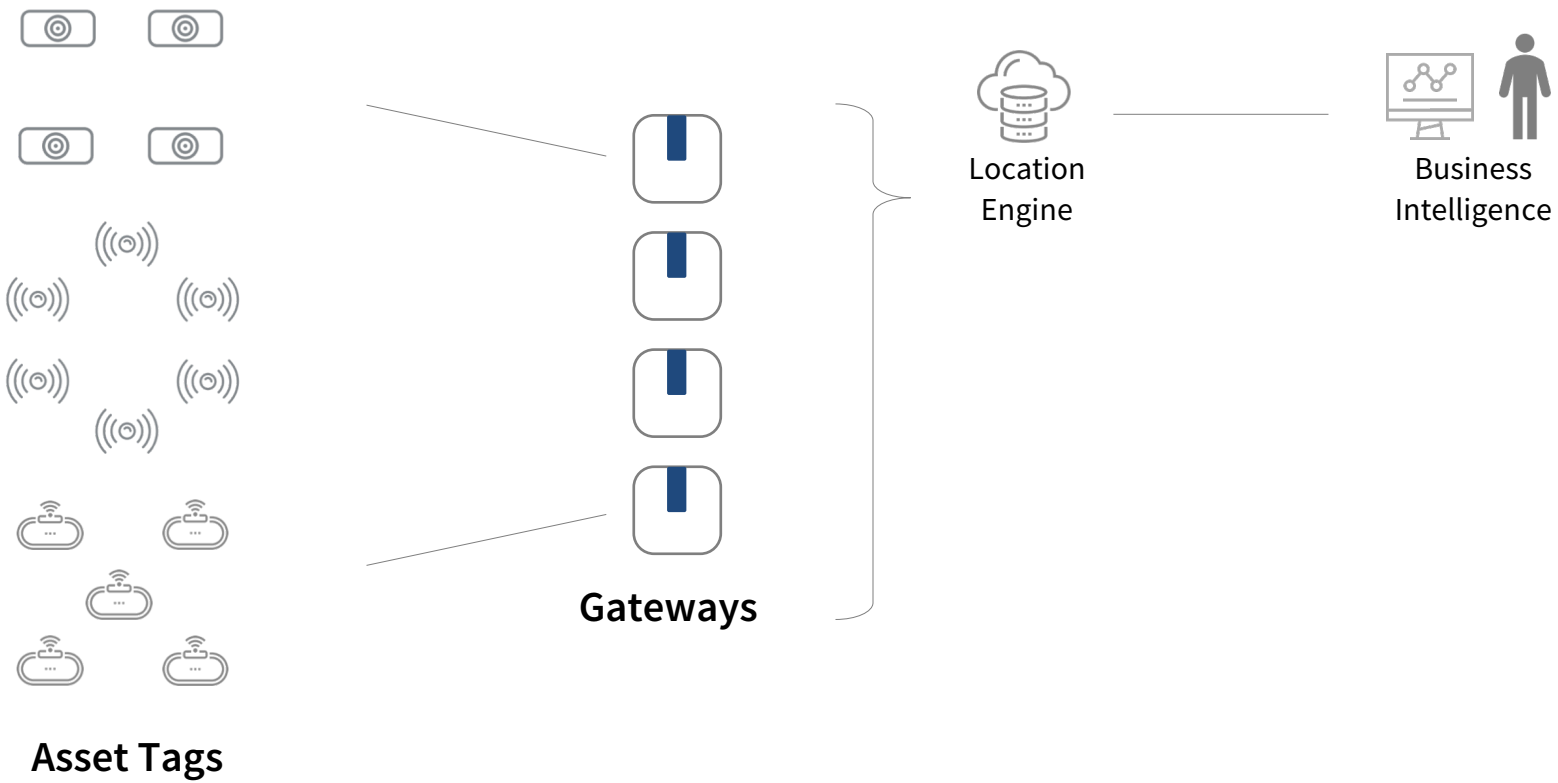
Advantages of BLE for Asset Tracking

- Trends of BLE chipsets driven by consumer markets in the last 4 years
  - TX Power consumption has dropped from 15.6mA to 5.0mA
  - RX -93 dBm @ 13mA to -96 dBm @ 5.4mA
  - More RAM / Flash / MHz
  - Lower cost

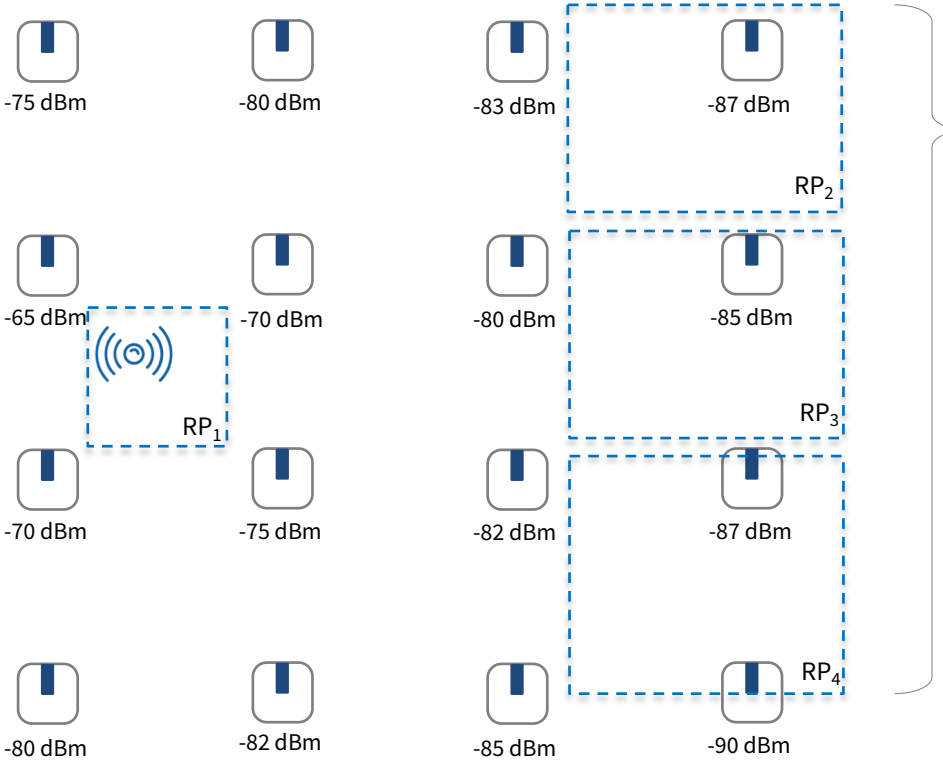


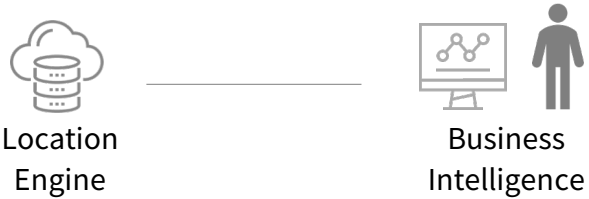
How are customers leveraging BLE for Asset Tracking **using Rigado**?

BLE Asset Tracking Solution Components



#1: Fingerprinting





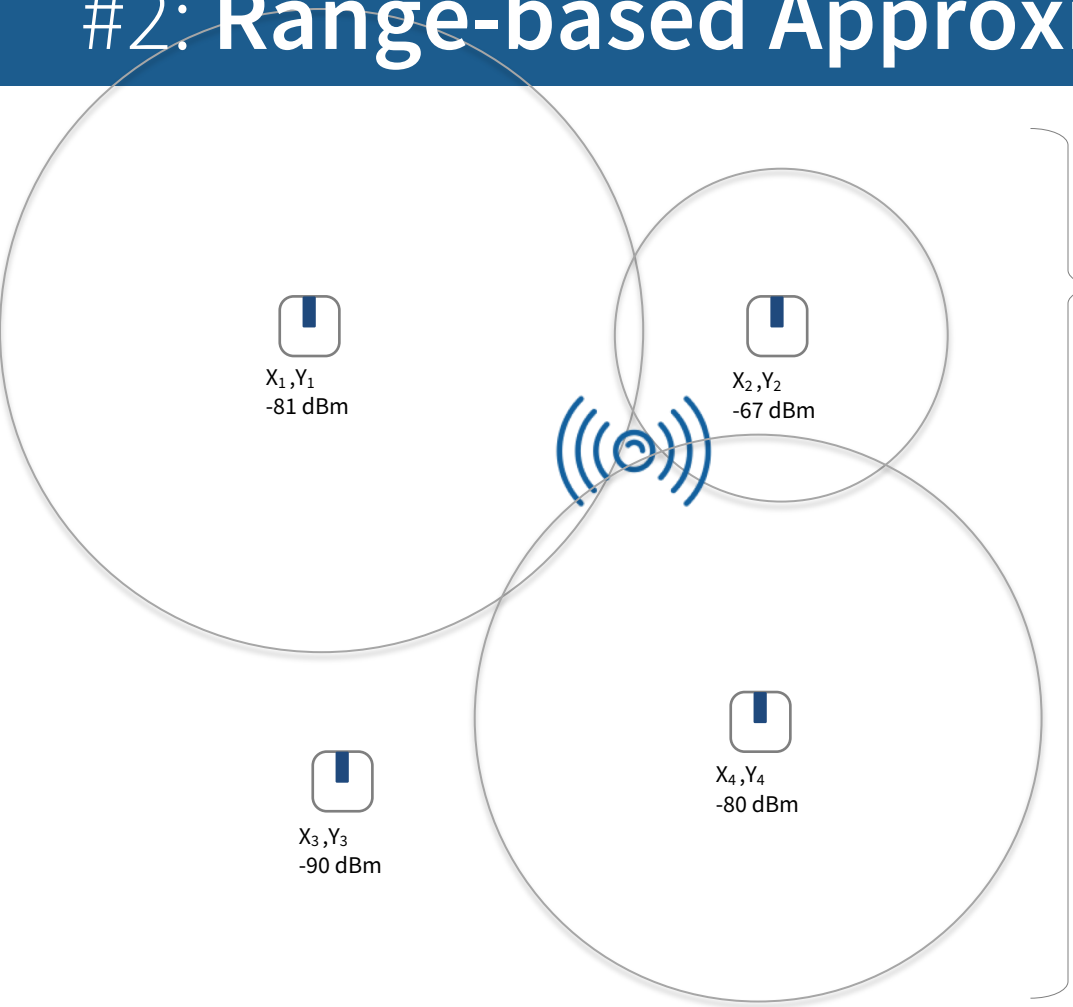
$$\text{Fingerprint}_{\text{data}} = \begin{bmatrix} \text{RSSI}_{B_1}(\text{RP}_1) & \text{RSSI}_{B_2}(\text{RP}_1) & \dots & \text{RSSI}_{B_M}(\text{RP}_1) \\ \text{RSSI}_{B_1}(\text{RP}_2) & \text{RSSI}_{B_2}(\text{RP}_2) & \dots & \text{RSSI}_{B_M}(\text{RP}_2) \\ \vdots & \vdots & \ddots & \vdots \\ \text{RSSI}_{B_1}(\text{RP}_N) & \text{RSSI}_{B_2}(\text{RP}_N) & \dots & \text{RSSI}_{B_M}(\text{RP}_N) \end{bmatrix},$$

$$D_j = \sum_{i=1}^{m} \sqrt{\left(\text{RSSI}_{i_{\text{online}}} - \text{RSSI}_{i_{\text{offline}}}\right)^2}.$$

#1: **Fingerprinting**

- Result looks like “Tag 123 is in region A”
- Many receivers
- Gateways don’t need to be in any pattern
  - Locations don’t need to be known
- Must “train” the system – uses Machine Learning
  - Better to have fewer regions to reduce computation

#2: Range-based Approximation



Location Engine

Business Intelligence

RSSI -> Range calculation

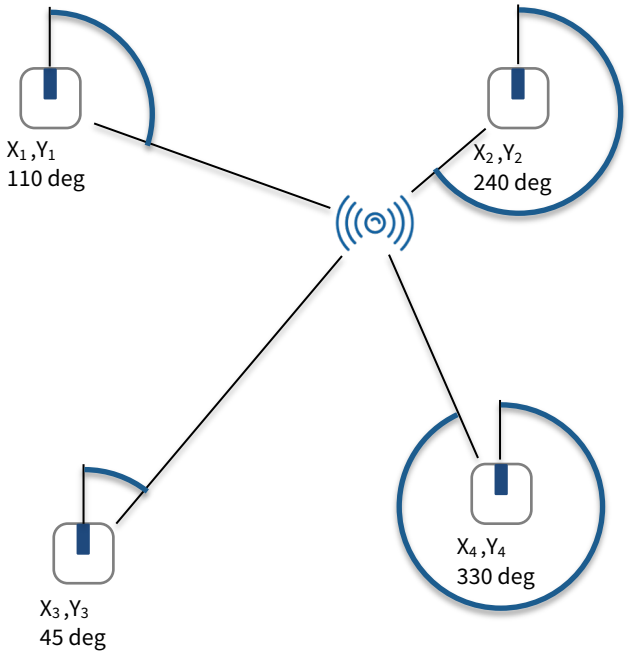
Range -> Intersecting arcs -> position

RIGADO

#2: **Range-based Approximation**

- Result looks like “Tag 123 is at position X,Y”
- Gateway locations need to be known
- RSSI can be noisy, adds error to range calculation
  - Antenna radiation pattern variation also adds noise
  - Different beacon vendors have different output power
- Region based results require defining geo-fences

#3: Angle from Gateway to Tag



Angle of Arrival

- directional antennas
- phase to multiple omni antennas

Intersecting vectors -> position

#3: **Angle from Gateway to Tag**

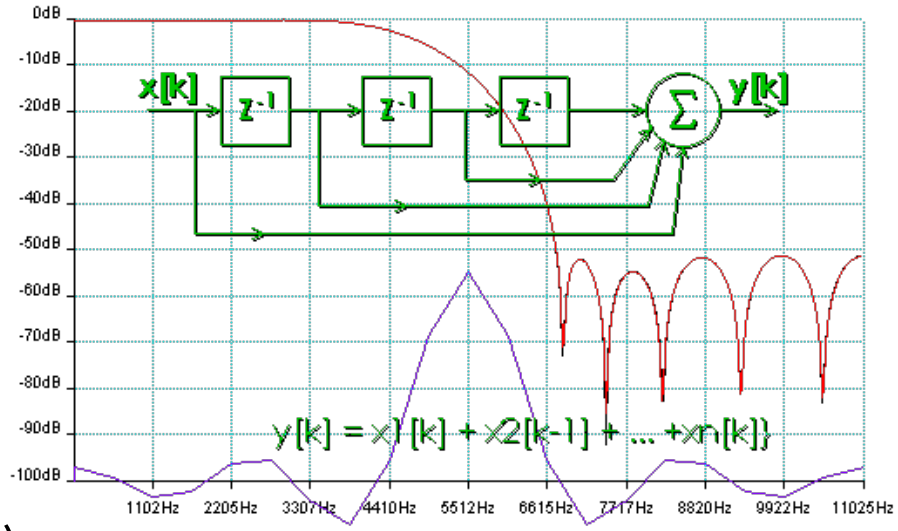
- Result looks like “Tag 123 is at position X,Y”
- Gateway locations need to be known
- RSSI can be noisy, adds error to angle calculation unless using non-RSSI techniques
- Region based results require defining geo-fences

Edge Processing for BLE / Asset Tracking

- BLE advertisement filtering
- RSSI smoothing
- Angle calculations

- Sensor data filtering
- Sensor threshold monitoring
- Sensor data reduction (cellular)

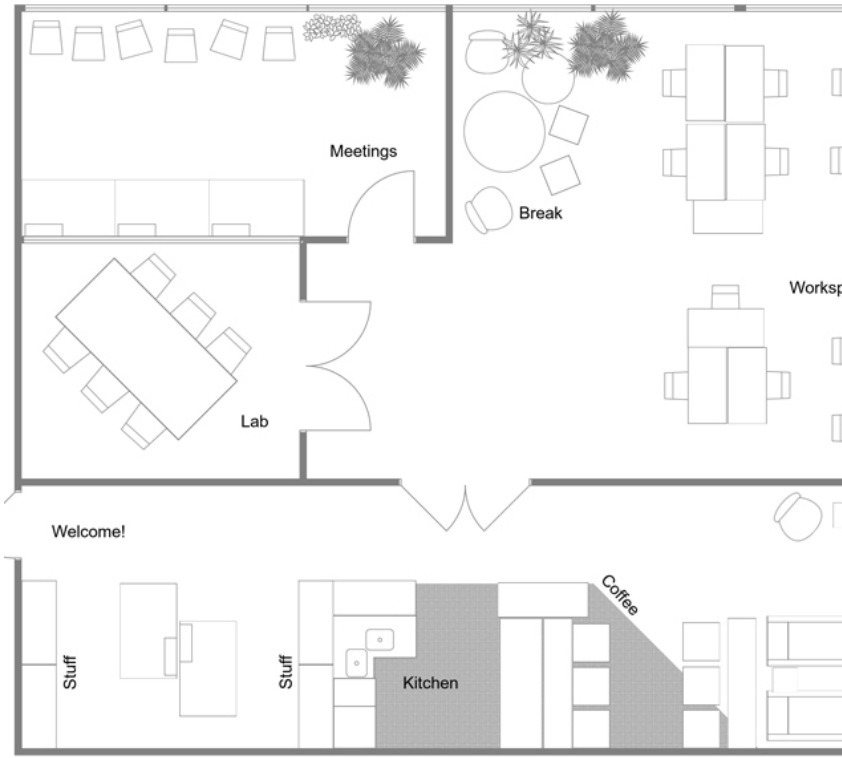
- Installation tools



What are we learning about
BLE Asset Tracking **at scale**?

Asset Tracking with BLE at Scale

- Installation cost is very important
  - Includes time to “train” the system
- Good floor plans are hard to find
  - Need to create while installing
- Location algorithms need iteration



Asset Tracking with BLE at Scale

- Antenna performance (how isotropic) affects accuracy
  - Both asset tag and Gateway
- Distributing software while creating better algorithms
  - Different deployment locations should have different versions
- IT depts demand Security audits and lock down Internet access

Rigado **BLE Solutions**

Cascade IoT **Gateways**

Connectivity

Bluetooth 5	including long-range
802.15.4	Zigbee & Thread
Wi-Fi	2.4 & 5 GHz
Ethernet	with PoE
LTE	Cat-1 with 2G/3G fallback

Computing

Processor	ARM Cortex A-7
RAM	512MB RAM
Storage	8 GB eMMC
Secure OS	Ubuntu Core
Secure Updates	via Cascade tools & API

Bluetooth 5 **Modules**

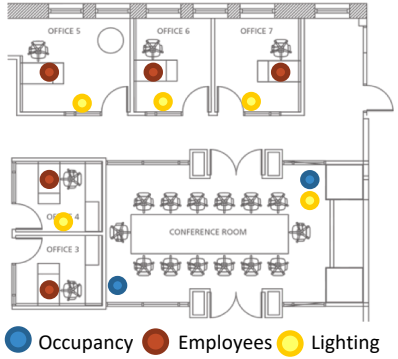
	BMD 300	BMD 301	BMD 350	BMD 330	BMD 340	R41Z
Wireless	Bluetooth 5	Bluetooth 5	Bluetooth 5	Bluetooth 5	Bluetooth 5 + 802.15.4	Bluetooth 4.2 + Thread
SoC	Nordic nRF52832	Nordic nRF52832	Nordic nRF52832	Nordic nRF52810	Nordic nRF52840	NXP KW41Z
Flash	512kB	512kB	512kB	192kB	1MB	512kB
RAM	64kB	64kB	64kB	24kB	256kB	128kB

How do Solution Providers use Cascade?

Asset Tracking

Radius Networks provides table delivery service to tens of thousands of restaurants. Rigado Gateways connect to beacons & report location.

Control & Automation



CBRE offers smart workplace solutions to its global tenants. Rigado Gateways link sensors and equipment to smart building services.

Sensing & Monitoring

OnSet provides a cold-chain monitoring service for vaccines. Rigado Gateways connect to temp monitors and push data to the cloud.

Thanks!

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