Global vision.
Local knowledge.

Cisco Connect Dubrovnik
Croatia • 27.–29.3.2019
Dizajn i use-casevi wireless mreža s omogućenim lokacijskim servisima potpomognutim CMX-om

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Systems Engineer
DNA Spaces

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Systems Engineer
Agenda

- Introduction
- Indoor Positioning
  - What is required for Hyperlocation
- Use Cases
  - Digitizing People
  - Digitizing Things
- How to use Location Data in 3rd party applications
  - Connecting 3rd party to Cisco DNA spaces APIs
- What about BLE?
12 years of Wi-Fi Location Based Services

**MSE 3300 MSE 7.0**
New more powerful hardware

**CMX 10.1**
New system architecture re-build from scratch

**Operational Insights**
Asset Management

**CMX Engage**
Wi-Fi enhanced Captive Portal and Analytics

**CMX 10.5.1**
Major OS Update
Data Privacy features to help with GDPR Compliance

**Cisco DNA Spaces**
Digitizing People and Things

**Location Appliance 2700**
Starting with Wireless Location

**MSE 7.0 – 8.0**
Adding first Wi-Fi Analytics

**07**

**10**

**14**

**18**

**19**
Simplifying the way customers consume location based services
Bringing all location services offerings together onto a single cloud platform that is extensible, scalable and reliable.

Compatibility and Interoperability across Cisco hardware (Aironet & Meraki) and software
Support across both next gen and previous gen wireless stack. Integration with DNA-C

Simplified Offer Structure, with a comprehensive feature set
Two subscription SKUs, making it easy to purchase

Enterprise class reliability
24 X 7 Deep Monitoring & End-to-End SLA
Wi-Fi Location
Introduction to Indoor Positioning
Location Tracking Approaches

- Real-time location tracking and positioning systems can be classified by the measurement techniques they employ to determine mobile device location.
- Approaches differ in terms of the specific technique used to sense and measure the position of the mobile device in the target environment.
- Real-Time Location Systems (RTLS) can be grouped into four basic categories of systems that determine position on the basis of the following:

  - Cell of origin (nearest cell)
  - Distance based (lateration)
  - Angle based (Angulation)
  - Location patterning
Cell of Origin

- One of the simplest mechanisms of estimating approximate location in any system based on RF cells is the concept of ‘cell of origin’ (or ‘associated access point’ in Wi-Fi 802.11 systems).

- When receiving cells, provide received signal strength indication (RSSI) for mobile devices; the use of the highest signal strength technique can improve location granularity over the cell of origin.
Distance-Based (Trilateration) Techniques

- Trilateration can be performed by using received signal strength (RSS)
- Measured by either the mobile device or the receiving sensor

The closer the distance the greater the rate of change in RSS in relationship to distance

The change in RSS in relationship to distance flattens out at greater distances
Angle-Based (Angulation) Techniques

- The AoA locates the mobile station by determining the angle of incidence at which signals arrive at the receiving sensor.
- Requires two receiving sensors for location estimation, with improved accuracy coming from at least three or more receiving sensors (triangulation).
Location Patterning (Fingerprinting)

- Location patterning is based on the sampling and recording of radio signal behavior patterns in specific environments.
- Each potential device location ideally possesses a distinctly unique RF "signature."

Because of fading and other phenomena, the observed signal strength of a mobile device at a particular location is not static but is seen to vary over time. As a result, calibration phase software typically records many samples of signal strength for a mobile device during the actual sampling process.
Where is data for location measured and calculated?

<table>
<thead>
<tr>
<th>Method</th>
<th>Data</th>
<th>Data Collection</th>
<th>Location Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS</td>
<td>TDOA</td>
<td>TOA</td>
<td>Mobile Device</td>
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### Where is data for location measured and calculated?

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<td>Infrastructure (AP)</td>
<td>Infrastructure (CMX)</td>
</tr>
<tr>
<td>Wi-Fi RSSI</td>
<td>Infrastructure (AP)</td>
<td>Infrastructure (CMX)</td>
</tr>
<tr>
<td>Wi-Fi Hyperlocation</td>
<td>Infrastructure (Hyperlocation AP)</td>
<td>Infrastructure (CMX)</td>
</tr>
<tr>
<td>Wi-Fi Location Patterning</td>
<td>Mobile Device (special chipset / driver)</td>
<td>Mobile Device or Infrastructure</td>
</tr>
<tr>
<td>BLE Beacon</td>
<td>Mobile Device</td>
<td>Mobile Device or Infrastructure</td>
</tr>
<tr>
<td>BLE Beacons for Location</td>
<td>Mobile Device</td>
<td>Mobile Device or Infrastructure (Fingerprint)</td>
</tr>
<tr>
<td>BLE Location</td>
<td>Infrastructure (AP with BLE RX)</td>
<td>Infrastructure (CMX)</td>
</tr>
</tbody>
</table>
What is required for Hyperlocation
AP4800
Hyperlocation + AP-3800 = AP-4800

Hyperlocation Components
Cisco 16 element Antenna Array
1-3m Accuracy

Hyperlocation Module

AP-4800 Integrated Solution

AP-3800
Dual 5GHz Monitor/Sensor

Proven Hyperlocation + 3800 Technology in one AP & 1 cable Drop

Improved Capability
- 802.11acW2
- WiFi & BLE AoA
- Time Based solutions
- + All the core features of the AP-3800

Hyperlocation Components
Inside AP-4800
Dual 5GHz XOR + another analytics Hyperlocation XOR radio

Antenna components

Hyperlocation Components
AP-36/3700
12x12"

AP-4800
Hyperlocation + Analytics
9.9x8.7"

40% smaller

Hyperlocation Components

AP-36/3700
12x12"

AP-4800
Hyperlocation + Analytics
9.9x8.7"

40% smaller

Hyperlocation Components
What do I need for Hyperlocation with AP4800?

- Cisco CMX appliance (High-End VM or HW 3365/3375) 10.5.1
- Cisco AireOS 8.8 or Cisco Catalyst 9800 IOS-XE 16.10 or later
- Floorplans: Map export from PI 3.5 or DNA-C 1.2.8
RTLS Basic Rules – often not followed

- Deploy minimum of 4 APs per floor
- One AP around client in each quadrant
- -75 dBm Client RSSI on 3 APs
- Create a convex hull around location area
Physical placement of APs for Hyperlocation

- AP spacing for Hyperlocation
  - 1 AP per 2500 Sq Ft / 230 m2
  - AP to AP distance < 50 ft / 15m
- Keep AP height < 15ft / 4.5m
- Site survey!
Figure 5-12 An Example of Location Aware Access Point Placement
Capture AP details

- Exact Map location of each AP with an accuracy of 1ft
- Capture distance to two walls or three points
- Orientation of the AP (Arrow)
  - Azimuth with an accuracy of 5 degrees
- AP name and MAC address
Prime Infrastructure – Wireless Maps

- Create map hierarchy: Campus – Building – Floor
- Properly size each floor
- Select best matching Floor Type (RF model)
- Add APs to floor and position them
  - Use 3 points or 2 walls for exact position
- Orientation / Azimuth must be entered correctly
- AP templates can help entering orientation of a bulk of APs
Cisco DNA Center – Wireless Maps

- Create map hierarchy: Campus – Building – Floor
  - Nested hierarchy is not yet supported on CMX
- Properly size each floor
- Select best matching Floor Type (RF model)
- Add APs to floor and position them
  - Use 3 points or 2 walls for exact position
  - Orientation / Azimuth must be entered correctly
Export Maps from PI or sync from Cisco DNA Center

- Maps -> Site Maps and select Export Map Archive from the drop down
- Include calibration information
Cisco CMX Installation

- AP 4800 Hyperlocation is supported from CMX 10.5 onwards and only on High-End virtual and MSE 3365/ CMX 3375 HW appliance
- After deploying OVA and before turning on increase disk size to 1 TB
- Change hostname / do not use localhost
- Valid NTP
- correct time-zone configuration
- Install as Location
Use Cases
Cisco DNA Spaces
The Blindspot at Physical Spaces

Limited visibility into behavior of people and things in physical spaces.

What if your Cisco Wireless Network could deliver more than connectivity?

Enterprises are missing out on billions of data points from their physical spaces everyday!
Digitizing Spaces: People & Things

Limited visibility into behavior of people and things in physical spaces

Cisco Wireless Network: Connectivity + Digitization
Digitizing Spaces: People & Things

SEE
See what’s happening at your properties:
• Unlock insights and trends into customer, employee and asset behavior.
• Industry standard location data
• Benchmark performance with industry.

ACT
Leverage Digitization Toolkits to act on insights:
• Translate network view of people and assets into business view.
• Trigger contextual notifications and workflows based on the behavior of people and assets.
• Leverage APIs to integrate with other applications.

EXTEND
Drive business outcomes:
• Location App Store for partner Apps.
• Extensions for enterprise software such as Marketing Automation, CRM, POS, Building Automation, HRMS, etc.
Cisco DNA Spaces
Cisco CMX + July Systems’ cloud platform

Simplify: Single pane for all location services

Standardize: Across all Cisco Aironet/Catalyst & Meraki infrastructure making it easy for customers and partners to succeed

Scale: Robust 5th Gen cloud engine delivers cleansed industry standard location data

Support: 24x7 monitoring end-to-end SLAs
Single Pane for All Location Services

Bringing all location services offerings together onto a single cloud platform that is extensible, scalable and reliable.

- Access to all location services offerings and apps from a single intuitive dashboard
- Role Based views for IT and Line of Business Users
- Multi-location and single location views for Executive teams and Property Managers respectively
Cisco DNA Spaces – Unified Location Cloud

- Unified Dashboard
- Insights
- Location
- Toolkits
- API
- SLA & Monitoring
- Security & Privacy

Independent Software Vendors (ISV)

Enterprise Software

Solution Partners

Cisco DNA Spaces

SEE

ACT

Presence Processor

Location Processor (X,Y)

Network Infrastructure

- WLC/Meraki
- Cloud Connector
- Cisco DNA Center
- Beacons
- Sensors & Tags
Supports all Cisco Wireless Topologies
Compatibility and Interoperability across Cisco hardware (Aironet, Catalyst, Meraki) and software

Cisco DNA Spaces

API / webhook
CMX On Prem 10.5
WLC/Cat9800

Tethering
Cloud enabled CMX On Prem 10.6
WLC/Cat9800

Direct connect
WLC 8.8 MR2
Cat9800 16.10.1
WLC 8.0+

Cisco DNA Spaces Connector 1.0
WLC/Cat9800

Cisco DNA Center
WLC/Cat9800

Meraki Cloud
Meraki

Network Infrastructure
Key Use Cases

Retail

• Understand shopper, associate behavior, benchmark performance, make informed decisions
• Acquire visitors, deliver relevant experiences through notifications
• Locate and monitor assets like shopping carts
• Monitor temperature, humidity of assets and sensors like refrigerators and trigger alerts

Hospitality

• Insights into guest, visitor and employee behavior. Benchmark performance
• Acquire and identify guests/members
• Deliver contextual on premises notifications
• Monitor and locate assets such as luggage trolleys

Workspaces

• Insights into employee and visitor behavior to measure workspace utilization, understand patterns
• Understand how conditions in the office and events impact employee behavior
• Trigger notifications, alerts and business workflows based on behavior of people and things
• Track and locate assets and monitor asset telemetry

Healthcare

• Insights into patient, visitor & staff behavior
• Onboard & acquire patients, visitors. Provide location & user specific information (links to services, retail, surveys, etc.)
• Avoid loss of lost medical equipment and reorder stock only as it runs low
• Ensure devices are in compliance with CDC
• Locate/track assets, monitor assets sensitive to environmental conditions and trigger alerts

Manufacturing

• Insights into employee and visitor behavior.
• Trigger alerts when equipment hasn’t been used in a long time, enter prohibited zones
• Automate data monitoring of equipment.
• Prevent inventory damage from environmental conditions
• Enhance your equipment paths of operation and make better workflows.

Education

• Insights into student, employee and visitor behavior
• Understand how events and variations impact behavior
• Trigger notifications, alerts and business workflows based on behavior of people and things
• Track and locate assets and monitor asset telemetry
Digitizing People
Business Insights
How are your locations performing on key metrics?

- Core behavioral Metrics & Indices

Wi-Fi Adoption

Measure the adoption of your Wi-Fi and make your Wi-Fi program successful

Business Metrics & Indices

Metrics and indices relevant to your vertical that measure the behavior of people within a physical space

Right Now Metrics

Gain a real-time view of visitor behavior at your properties
Business Insights: Email Digest

Key metrics delivered straight to your inbox

An automated email digest that gives you a snapshot of your building’s performance
<table>
<thead>
<tr>
<th><strong>Data Reliability</strong></th>
<th><strong>Data Accuracy</strong></th>
<th><strong>Data Normalization</strong></th>
<th><strong>Industry Standard Metrics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>System to identify potential issues in input data stream and trigger alerts</td>
<td>Industry specific Machine Learning based visitor classification</td>
<td>Normalizing metrics to ensure comparability</td>
<td>Standardizing computation of ‘time spent’ and ‘visits’</td>
</tr>
<tr>
<td><strong>Data Interruption:</strong> Data not received from a location</td>
<td>Isolating core group to be measured (Example: shoppers in retail, non guest visitors in hospitality, etc.)</td>
<td>Conversion of absolute to relative data and normalizing the size factor to ensure comparability across metrics and locations.</td>
<td>Location Hierarchy - translate network view to business taxonomy</td>
</tr>
<tr>
<td><strong>Data Reconciliation:</strong> Visit’s data not tallying with data on ‘connected’</td>
<td>Extraction of non core groups who are likely to significantly skew data (Employees, transients, etc.)</td>
<td>Per capita, Indices, proportions, percentages, ratios, etc.</td>
<td>Time limit for visit classification is also customized (Example: Not limited to one day in the case of hotels)</td>
</tr>
<tr>
<td><strong>Data Variance:</strong> values abnormally higher or lower than average</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Data Privacy & Compliance**
Business Insights at CLEUR 2019
Cisco DNA Spaces - Dashboard
Visitor Distribution by Hour of Day
Location Personas – Technical Seminars

RULE NAME
TechnicalSeminar

SENSE
When user is on WiFi and present at location for 120 minutes

LOCATIONS
For all locations under HB-L0

AUDIENCE

SCHEDULE
Starts from 28 January 2019 to 28 January 2019

ACTION
Tag user as TechnicalSeminar
Location Personas – Explorer

Summary

Rule Name: Explorer
Sense: When user is on WiFi and present at location for 60 minutes
Locations: Hall8-Hub-Keynote, Hall7-WebS
Audience
Schedule
Action: Tag user as Explorer

User Profile
- 62.8% Explorer
- 22.9% Technical/Presenter
- 14.1% Exhibitor
- 0.8% Brendak

Segmentation by User-Defined Tags

Check Time
- 181 MINUTES Average Time

Number of Visits
- 3.7 Average Visits
Captive Portals

- Targeted engagements at zero click

- Seamlessly onboard and acquire visitors at your properties.
- Map to CRM/loyalty systems and expand loyalty programs
- Promote enterprise services and drive monetization through sponsorships
- Access onboarding and acquisition reports and integrate with enterprise workflows

Deliver targeted engagements at zero click

Where to show
- Example: Brand, Location, Geography, etc.

When to show
- Example: Weekdays/Weekends, Days of week, 5 PM, etc.

Who to show
- Persona, Based on location and behavior

What to show
- Example: Relevant services specific to that day/time

How to show
- Contextual API & Marketing Cloud Integration
Location Personas

- Profile customers based on their at-location behavior

- **Set profile rules to tag and segment visitors** based on their behavior at your spaces

- **Identify key segments/personas** and get a detailed picture of their in-location behavior

- **Deliver relevant engagements** based on personas

- Integrate location personas with personas across other channels to create a **360-degree view of customers**.
Engagements

• Leveraging the Ideal Channel at the Right Time and Place

• Trigger contextual multi-channel engagements based on the behavior of visitors

• Notify staff real-time of visitor’s presence through API triggers and WebEx teams notifications to deliver a differentiated experience

• Leverage location hierarchy and personas to deliver the right engagement at the right place and right time

• Integrate with backend systems and workflows such as Marketing cloud, CRM, PMS, Associate Notification systems, etc.
Digitizing Things
Cisco DNA Spaces
Operational Insights
Operational Insights

- Driven by intent, informed by context

**Tag**
Clients, Wi-Fi or Bluetooth Low Energy (BLE) tags on assets

**Classify**
Classify tagged assets by location, type, and more

**Rules**
Create rules and alert notifications for assets

**Track and trace**
Track and analyze telemetry data from assets

**Alerts**
Trigger alerts based on a set of actions

**Reports**
Generate historical data in customizable reports
• Easy-to-use and intuitive interface
• Tracking, alerting and reporting system.
• Scalable infrastructure via cloud ecosystem
• SaaS for faster deployment and cost efficiency

• Leverage existing wireless infrastructure
• Technology agnostic – works on Wi-Fi, BLE or both

• Track Wi-Fi devices and CCX compliant tags from any vendor
• Track assets with BLE tags
• Get data from CCX compliant tags
Healthcare Industry

Equipment Inventory Tracking
• Avoid loss of lost medical equipment and save money by reordering stock only as it runs low.

Safety and Compliance
• Save costs by making sure your devices are in compliance with CDC.
• Prevent inventory damage from environmental conditions.

Workflow Optimization
• Improve efficiency and save costs by understanding your staff flow and dwell times in your facility.
Manufacturing Industry

Asset and Inventory Tracking
- Avoid loss of costly inventory and save money by reordering stock only as it runs low.

Device level telemetry
- Save money on maintenance and inspections by automating data collection and monitoring of your equipment.
- Prevent damage of your inventory from environmental conditions inside your facility.

Machine utilization
- Improve efficiency and save costs by enhancing your equipment paths of operation and making better workflows.
Retail Industry

Cart and basket tracking
- Save staff time dedicated to locate carts and baskets.

Fridge temperature monitoring
- Avoid waste in your inventory by monitoring products sensitive to temperature (vegetables, dairy, frozen food, etc.).

Improve Store Operations
- Increase customer satisfaction by always having their online pickup order ready and fresh.
Main Dashboard

- Customized access to data per user role.
- Available locations showed on interactive map.
- Snapshot total Assets available to this user.
- Outstanding alerts.
Locator - List View

Customizable Widgets
Quick Filters

Tools
Export, Filter and customize view

Click on Asset
For location and details
Rules – Who, Why, When, What or IfTTT

- Set conditions
  - Location
  - Attribute
  - Battery Level
  - Temperature
  - Button press
  - Etc.

- Information
  - Name, Description
  - Priority

- Select Assets
  - By Department, Category, etc.

- Actions
  - E-Mail
  - SMS
  - HTTP POST
  - Attribute Update
Push button to Webwx Teams Bot

Condition
Button 1 pressed

Action
HTTP Post to Webex Teams Bot

Trigger Options
Immediate
Reporting – Example for Temperature Tags

Temperature Graph

Temperature Table

Refill

With warm bottles
How to integrate 3rd Party Applications
Powering Business Outcomes through Partners

Independent Software Vendors
Enable vertically-relevant, pre-validated LBS applications through the partner App Store

Enterprise Software
Integrate location data with Enterprise Software platforms to develop deeper insights about your customers, employees, and assets

Solution Providers
Work with third party application developers to build customized applications for individual businesses leveraging Cisco DNA Spaces APIs
Cisco DNA Spaces - APIs

- Metrics API
  - Comprehensive toolbox for developing on the platform and extending functionality
- Location Hierarchy
- Presence
- Integration APIs
  - Create your own views as well as extend available metrics to derive meaningful inferences relevant to your business
- Processed Location (X,Y)
- Trigger API
How Cisco CMX Works (CMX 10.x)

- Use CMX API to enhance 3rd Party Application or App
- Controller (Virtual/Physical)
- CMX (Virtual/Physical)
- Depending on Application Layer
- Realtime Notifications
- Pull Data REST API
Application host requirements

• Push method using CMX northbound notifications.
  • For realtime you can setup northbound notifications on CMX to be send to the application host. This would not require the application host to connect to CMX and the host could then be even hosted in the cloud.

• Pull method using REST API
  • You need to put the application host in the DMZ, application host needs to be able to do REST API calls to CMX.
What can you do with the APIs

• Airport
  • Queue Monitoring
    • Waiting Times at Security
  • Footfall in shopping area

• City Metro
  • Utilization of different Stations
  • Optimization of train sizes
  • Where do people hop-on and hop-off the train.

• Enterprise
  • Office Space Utilization
Wayfinding at CLEUR 2019
Cisco Event App

- Browser based map
- Easy integration into any mobile app
- Map POIs to URLs
Find my Friends

- Create a Group
- Send Invite link to your friends
  - Via Spark, E-Mail, WhatsApp, SMS, ...
- Your friends click on the link and become member of the group
Indoor Maps - From CAD to mobile optimized

www.mazemap.com
Architecture: Cisco and Mazemap

- CMX Integration
- CMX API
- LIPI server
- MazeMap
- Cisco Enterprise WiFi Infrastructure
- WiFi AP Location
- Positioning request
- Client accessing MazeMap
- NAT

Architecture:
- NAT
- Cisco Enterprise WiFi Infrastructure
- CMX
- CMX API
- LIPI server
- WiFi AP Location
- Positioning request
- Client accessing MazeMap
- MazeMap

Diagram showing:
- NAT
- Cisco Enterprise WiFi Infrastructure
- CMX
- CMX API
- LIPI server
- WiFi AP Location
- Positioning request
- Client accessing MazeMap
- MazeMap

Diagram with arrows indicating flow between NAT, Cisco Enterprise WiFi Infrastructure, CMX, CMX API, LIPI server, WiFi AP Location, Positioning request, Client accessing MazeMap, and MazeMap.
BLE
Beacon Management
## Why BLE for these use cases?

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Why BLE ?</th>
<th>Others Options used</th>
</tr>
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<tr>
<td><strong>Proximity Messaging</strong></td>
<td>Installed Mobile Applications can wake from sleep when a BLE Beacon is detected and push messages to users screen when application is not in foreground.</td>
<td>GPS based app notification messaging is limited to about 100ft of accuracy. WiFi based messaging relies on the client joining the WIFI network.</td>
</tr>
<tr>
<td><strong>Indoor Wayfinding</strong></td>
<td>Mobile devices makers allow map applications to read reported values from the BLE radio every 500ms providing the fastest update rate for indoor location and this results in more accurate indoor location.</td>
<td>WiFi network based indoor wayfinding can provide an update approximately every 3 seconds at best.</td>
</tr>
<tr>
<td><strong>Asset Tracking</strong></td>
<td>BLE Chipsets continue to get cheaper and are being integrated into more products. This leads to cheaper asset tracking tags.</td>
<td>WiFi RFID asset tags can have a better level of accuracy, however, they are more expensive and do not have as many advances in chip technology.</td>
</tr>
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</table>
BLE Manager & Cisco DNA LTX

• Automating beacon management

• **Enterprise wide management of BLE radios** inside of Cisco AP as well as Cisco DNA LTX compatible Floor Beacons (coming soon)

• **Eliminate technical overlay** needed to network and manage physical beacons, as well as the **manual overhead** required to maintain them.

• Configure the BLE Radio on an AP at a specific location to beacon out in a specific manner.

*LTX Location and Telemetry Exchange*
Highlights of Cisco DNA LTX

Discovery & secure onboarding of third party tags

Ensuring packet integrity & data confidentiality

Establishing secure channel Provisioning & rotating keys

Life cycle management of tags Power & topology aware Intelligent processing

Cisco DNA LTX

Onboarding

Provisioning

Security

Managing
Beacon Management for AP based BLE

- AP4800 / w built-in
- AP1815i / w built-in

- WLC AirOS 8.7 required
- Management via CMX Beacon Management Cloud
- Configuration via WLC GUI/CLI not supported
BLE Location

- CMX 10.6 / AireOS 8.9
- Locate BLE devices
  - BLE Tags
  - BLE Beacons
- Send to Operational Insights
Conclusion

- **Wi-Fi Location**
  - accuracy of up to 1–3m
  - Update rate of up to 5s
  - Does not require a mobile app

- **BLE Location**
  - Always requires an mobile app
  - Update rate of up to 500ms
  - Wi-Fi analytics is not an exact people counter